

MECHANICAL(H4DO)

ME(H4DO)

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MECHANICAL(H4DO) > General Description

CAUTION

- When performing service operation, refer to "Repair Contents" in "General Description".  [Ref. to REPAIR CONTENTS>Repair Contents.](#)
- Prior to starting work, pay special attention to the following:
 1. Always wear work clothes, a work cap, and protective shoes. Additionally, wear a helmet, protective goggles, etc. if necessary.
 2. Protect the vehicle using a seat cover, fender cover, etc.
 3. Prepare the service tools, clean cloth, containers to catch grease and oil, etc.
- Prevent scattering of grease and oil. If it scatters, wipe it off immediately to prevent it from penetrating the floor or flowing out, to protect the environmental.
- If the grease and oil is spilt over the engine, exhaust pipe or the under cover, completely wipe it off to avoid emission of smoke or causing a fire.
- Vehicle components are extremely hot immediately after driving. Be wary of receiving burns from heated parts.
- When performing a repair, identify the cause of trouble and avoid unnecessary work.
- Before disconnecting connectors of sensors or units, be sure to disconnect the ground terminal from the battery sensor.
- Always use the jack-up point when the lifting device, shop jacks or rigid racks are used to support the vehicle.
- Be careful not to let any oil or grease contact the clutch disc or flywheel. (MT model)
- Before starting works, remove dirt and corrosion around the target area.
- Keep the removed parts in order and protect them from dust and dirt.
- All removed parts, if to be reused, should be reinstalled in the original positions with attention to the correct directions, etc.
- For the parts except for the non-reusable parts, replace them with new parts if necessary.
- Be sure to tighten bolts and nuts to the specified torque.
- Always use new application oil during work.
- When working on the fuel lines, place "NO OPEN FLAMES" signs near the working area.
- Always ventilate sufficiently when working on the fuel lines.
- Always inspect for fuel leaks after working on the fuel lines is completed.
- Follow all government and local regulations concerning disposal of refuse when disposing grease and oil.
- Remove or install the engine in an area where lifting devices, chain hoists, etc. are available for ready use.

MECHANICAL(H4DO) > General Description

SPECIFICATION

1. ENGINE

Model	2.4 L
Cylinder arrangement	Horizontally opposed, liquid cooled, 4-cylinder 4-stroke gasoline engine
Valve system mechanism	Chain driven, double overhead

			camshaft, 4-valve/cylinder
Bore × Stroke	mm (in)		94.0 × 86.0 (3.70 × 3.39)
Displacement	cm ³ (cu in)		2,387 (146)
Compression ratio			12.5
Compression pressure (at 200 – 300 r/min)	kPa (kg/cm ² , psi)	Stand ard	1,390 – 1,735 (14 – 18, 202 – 252)
Number of piston rings			Compression ring: 2 Oil ring: 1
Intake valve timing	Open	Max. retard	ATDC 34°
		Min. advance	BTDC 44°
	Close	Max. retard	ABDC 109°
		Min. advance	ABDC 31°
Exhaust valve timing	Open	Max. retard	BBDC 27°
		Min. advance	BBDC 82°
	Close	Max. retard	ATDC 45°
		Min. advance	BTDC 10°
Cam clearance	mm (in)	Intake Stand ard	0.13 ^{+0.02} _{-0.03} (0.0051 ^{+0.0008} _{-0.0012})
		Exhaust Stand ard	0.22 ±0.02 (0.0087±0.0008)
Idle speed (For AT model, select lever in "P" or "N" range. For MT model, gear shift lever in neutral position.)	No load	Stand ard	AT model: 700±50 MT model: 650±50
		A/C ON	700 – 870±50
Ignition order			1 → 3 → 2 → 4
Ignition timing	BTDC/{r/min}	Stand ard	AT model: 13°±10°/700 MT model: 12°±10°/650

2. CAMSHAFT

Bending			mm (in)	Limit	0.020 (0.0008)
Cam lobe height	mm (in)	Intake	Valve drive section	Stand ard	40.19 — 40.29 (1.5823 — 1.5862)
			Fuel pump drive section	Stand ard	44.94 — 45.06 (1.7693 — 1.7740)
		Exhaust		Stand ard	39.51 — 39.61 (1.5555 — 1.5594)
Cam base circle diameter			mm (in)	Stand ard	34.0 (1.3386)
Journal outer diameter			mm (in)	Stand ard	25.946 — 25.963 (1.0215 — 1.0222)
Thrust clearance			mm (in)	Stand ard	0.068 — 0.116 (0.0027 — 0.0046)
Oil clearance			mm (in)	Stand ard	0.037 — 0.072 (0.0015 — 0.0028)

3. CYLINDER HEAD

Warpage (mating surface with cylinder block)	mm (in)	Limit	0.020 (0.0008)
Grinding limit	mm (in)		98.45 (3.8760) or less
Height	mm (in)	Stand ard	98.5 (3.8779)

4. VALVE & VALVE GUIDE

Valve overall length	mm (in)	Intake		104.95 (4.1319)
		Exhaust		96.53 (3.8004)
Valve head edge thickness	mm (in)	Intake	Stand ard	0.8 — 1.2 (0.0315 — 0.0472)
		Exhaust	Stand ard	1.0 — 1.4 (0.0394 — 0.0551)
Valve stem outer diameter	mm (in)	Intake	Stand ard	5.455 — 5.470 (0.2148 — 0.2154)
		Exhaust	Stand ard	5.445 — 5.460 (0.2144 — 0.2150)
Valve guide inner diameter	mm (in)	Stand ard		5.500 — 5.512 (0.2165 — 0.2170)
Clearance between valve and valve guide	mm (in)	Intake	Stand ard	0.030 — 0.057 (0.0012 — 0.0022)
		Exhaust	Stand ard	0.040 — 0.067 (0.0016 — 0.0026)
Valve guide protrusion amount	mm	Intake	Stand ard	14.6 — 15.0 (0.5748 — 0.5906)

	(in)	Exhaust	Stand ard	11.6 – 12.0 (0.4567 – 0.4724)
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5. VALVE & VALVE SHIM

Valve stem end outer diameter	mm (in)	Intake	Stand ard	5.455 – 5.470 (0.2148 – 0.2154)
		Exhaust	Stand ard	5.445 – 5.460 (0.2144 – 0.2150)
Valve shim inner diameter		mm (in)	Stand ard	5.500 – 5.560 (0.2165 – 0.2189)
Clearance between valve and valve shim	mm (in)	Intake	Stand ard	0.030 – 0.105 (0.0012 – 0.0041)
		Exhaust	Stand ard	0.040 – 0.115 (0.0016 – 0.0045)

6. VALVE SEAT

Seating width between valve and valve seat	mm (in)	Intake	Stand ard	0.8 – 1.6 (0.0315 – 0.0630)	
		Exhaust	Stand ard	1.1 – 1.7 (0.0433 – 0.0669)	
Seating angle between valve and valve seat			45°		
Seating position between valve and valve seat			Valve face center		

7. VALVE SPRING

Free length (reference)	mm (in)	Intake	Stand ard	44.55 (1.7539)
		Exhaust	Stand ard	42.03 (1.6547)
Tension/spring height	N (kgf, lbf)/mm (in)	Intake	Stand ard	182 – 210 (18.56 – 21.41, 40.92 – 47.21)/ 36.2 (1.4252)
		Exhaust	Stand ard	182 – 210 (18.56 – 21.41, 40.92 – 47.21)/ 34.2 (1.3465)
		Intake	Stand ard	514 – 568 (52.41 – 57.92, 115.57 – 127.71)/ 25.21 (0.9925)
		Lift	Stand	504 – 558 (51.39 – 56.90, 113.32 –

	Exhaust	ard	125.46)/ 24.30 (0.9567)
Squareness	Intake	Stand ard	2.5°, 1.9 mm (0.0748 in) or less
	Exhaust	Stand ard	2.5°, 1.8 mm (0.0709 in) or less

8. CYLINDER BLOCK & PISTON

Cylinder block warpage (Mating surface with cylinder head)	mm (in)	Limit	0.025 (0.0010)	
Grinding limit of cylinder block	mm (in)		204.95 (8.0689) or less	
Height of cylinder block	mm (in)	Stand ard	205.0 (8.0709)	
Inner diameter of cylinder liner	mm (in)	Cylinder bore size mark A	Stand ard	94.005 — 94.015 (3.7010 — 3.7014)
		Cylinder bore size mark B	Stand ard	93.995 — 94.005 (3.7006 — 3.7010)
Cylindricality of cylinder liner	mm (in)	Limit	0.030 (0.0012)	
Out-of-roundness of cylinder liner	mm (in)	Limit	0.030 (0.0012)	
Piston grade point	mm (in)		35.9 (1.4134)	
Piston outer diameter	mm (in)	Stand ard Size	Grade A	93.985 — 93.995 (3.7002 — 3.7006)
		Grade B	93.975 — 93.985 (3.6998 — 3.7002)	
		0.25 (0.0098) oversize	94.225 — 94.245 (3.7096 — 3.7104)	
		0.50 (0.0197) oversize	94.475 — 94.495 (3.7195 — 3.7203)	
Clearance between cylinder liner and piston	mm (in)	Stand ard	0.010 — 0.030 (0.0004 — 0.0012)	
Inner diameter of cylinder liner boring limit (diameter)	mm (in)		94.505 (3.7207) or less	

9. PISTON AND PISTON PIN

Degree of fit	Piston pin must be fitted into position with thumb at 20°C (68°F).		
Clearance between piston and piston pin	mm (in)	Stand ard	0.004 — 0.008 (0.0002 — 0.0003)

10. PISTON RING

Closed gap mm (in)	Compression ring	Top ring	Stand ard	0.22 – 0.27 (0.0087 – 0.0106)
		Second ring	Stand ard	0.35 – 0.45 (0.0138 – 0.0177)
	Oil ring (Upper rail and lower rail)		Stand ard	0.10 – 0.35 (0.0039 – 0.0138)
Clearance between compression ring and piston	mm (in)	Top ring	Stand ard	0.030 – 0.080 (0.0012 – 0.0031)
		Second ring	Stand ard	0.030 – 0.070 (0.0012 – 0.0028)

11. CONNECTING ROD AND CONNECTING ROD BEARING

Thrust clearance	mm (in)	Stand ard	0.070 – 0.330 (0.0028 – 0.0130)
Connecting rod bearing thickness (at center)	mm (in)	STD1	Stand ard
		STD2	Stand ard
		STD3	Stand ard
Oil clearance	mm (in)	Stand ard	0.025 – 0.055 (0.0010 – 0.0022)

12. PISTON PIN & CONNECTING ROD BUSHING

Clearance between piston pin and connecting rod bushing	mm (in)	Stand ard	0.006 – 0.026 (0.0002 – 0.0010)
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13. CRANKSHAFT AND CRANKSHAFT BEARING

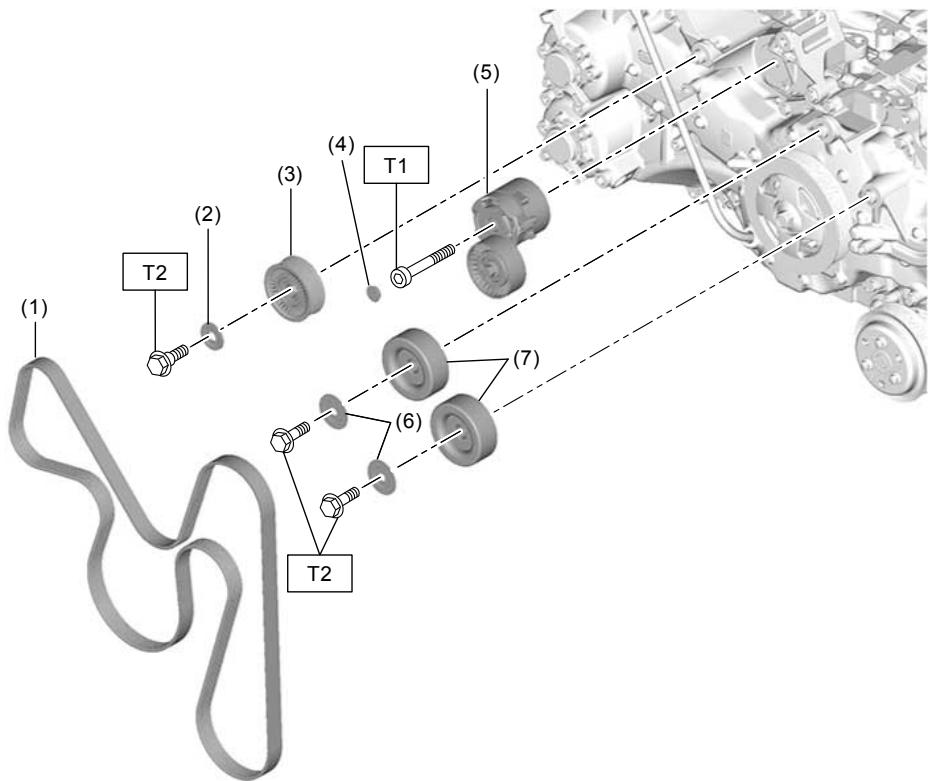
Bending	mm (in)	Limit	0.035 (0.0014)
Crankshaft pin	Cylindricality mm (in)	Limit	0.006 (0.0002)
	Out-of- roundness mm (in)	Limit	0.005 (0.0002)
	Service limit (dia.) mm (in)		51.976 (2.0463) or less
Crankshaft journal	Cylindr icity mm (in)	Limit	0.006 (0.0002)
	Out-of- roundn ess mm (in)	Limit	0.005 (0.0002)
	Service limit (dia.) mm (in)		67.985 (2.6766) or less

Crankshaft bearing thickness (at center)	mm (in)	#1, #2, #3, #4	STD0 (#2, #4)	Stand ard	2.513 — 2.516 (0.0989 — 0.0991)	
			STD1	Stand ard	2.510 — 2.513 (0.0988 — 0.0989)	
			STD2	Stand ard	2.507 — 2.510 (0.0987 — 0.0988)	
			STD3	Stand ard	2.504 — 2.507 (0.0986 — 0.0987)	
			STD4	Stand ard	2.501 — 2.504 (0.0985 — 0.0986)	
			STD5 (#1, #3)	Stand ard	2.498 — 2.501 (0.0983 — 0.0985)	
	#5	STD0	Stand ard	2.511 — 2.514 (0.0989 — 0.0990)		
			Stand ard	2.508 — 2.511 (0.0987 — 0.0989)		
			Stand ard	2.505 — 2.508 (0.0986 — 0.0987)		
			Stand ard	2.502 — 2.505 (0.0985 — 0.0986)		
			Stand ard	2.499 — 2.502 (0.0984 — 0.0985)		
Thrust clearance	mm (in)		Stand ard	0.130 — 0.308 (0.0051 — 0.0121)		
Oil clearance	mm (in)		Stand ard	0.013 — 0.031 (0.0005 — 0.0012)		

MECHANICAL(H4DO) > General Description

COMPONENT

1. V-BELT AND V-BELT TENSIONER



ME-23179

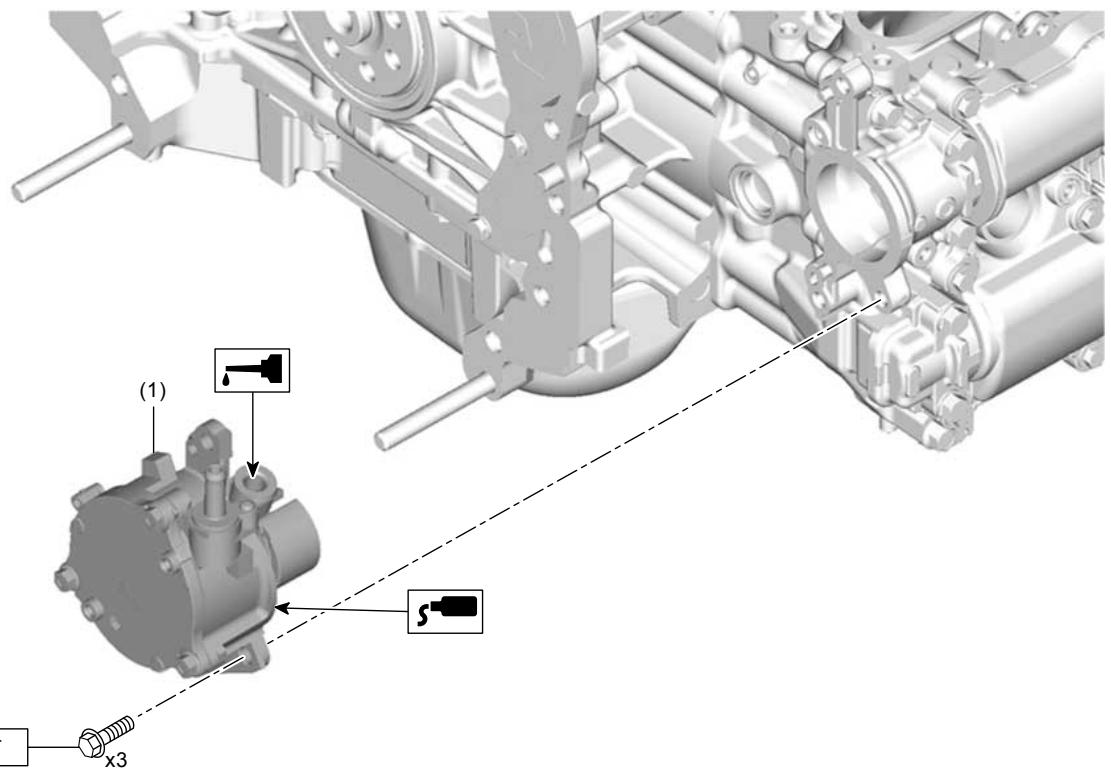
- (1) V-belt
(2) Idler pulley cover
(3) Idler pulley No. 1
(4) Cap
(5) V-belt tensioner ASSY
(6) Idler pulley cover
(7) Idler pulley No. 2 & Idler pulley No. 3

Tightening torque: N·m (kgf-m, ft-lb)

T1: 25 (2.5, 18.4)

T2: 36 (3.7, 26.6)

2. VACUUM PUMP



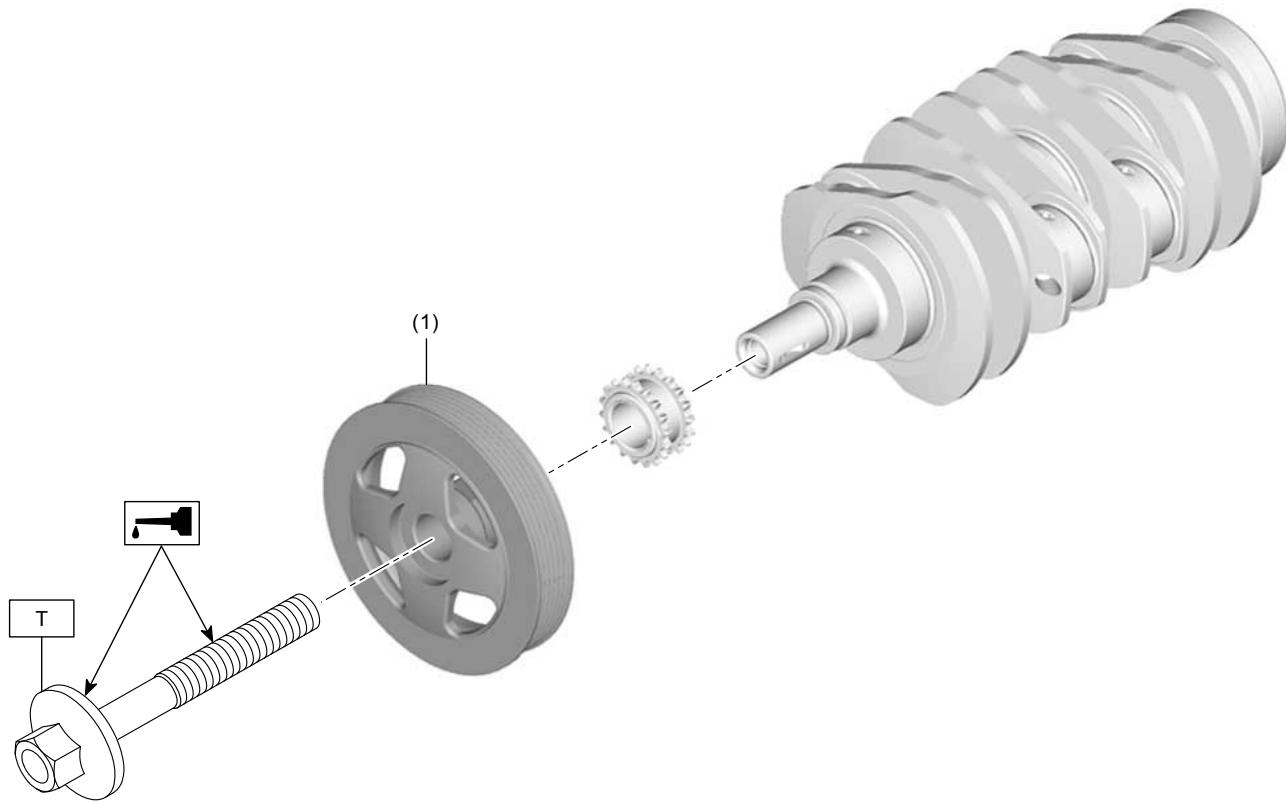
ME-23180

(1) Vacuum pump

**Tightening torque: N·m (kgf·m,
ft-lb)**

T: 16 (1.6, 11.8)

3. CRANK PULLEY



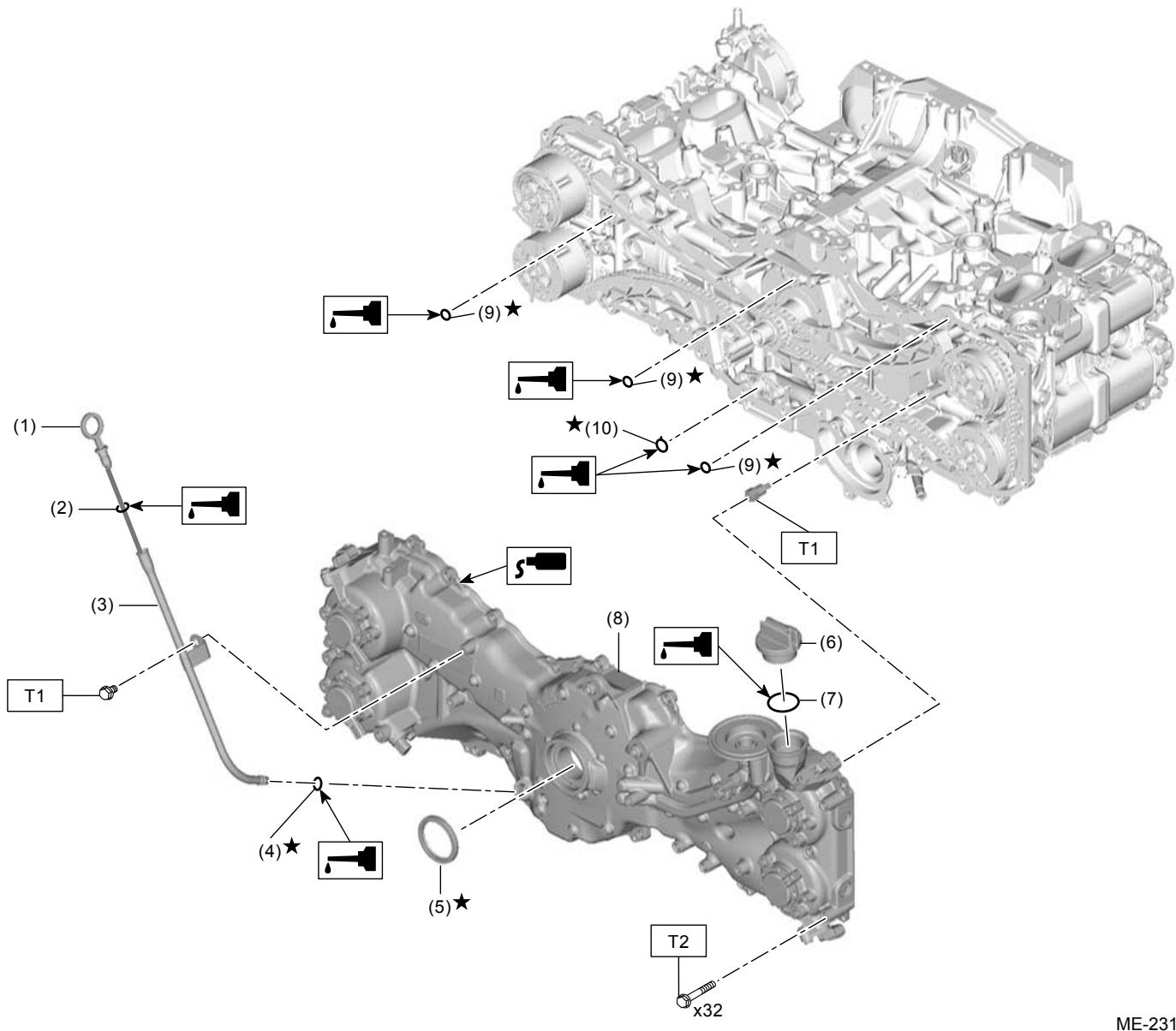
ME-23188

(1) Crank pulley

Tightening torque: N·m (kgf-m, ft-lb)

T: [Ref. to
MECHANICAL\(H4DO\)>Crank Pulley>INSTALLATION.](#)

4. CHAIN COVER



ME-23181

(1) Oil level gauge

(6) Oil filler cap

Tightening torque: N·m (kgf-m, ft-lb)

(2) O-ring

(7) Gasket

T1: 6.4 (0.7, 4.7)

(3) Oil level gauge guide

(8) Chain cover

**T2: Ref. to
MECHANICAL(H4DO)>Chain
Cover>INSTALLATION.**

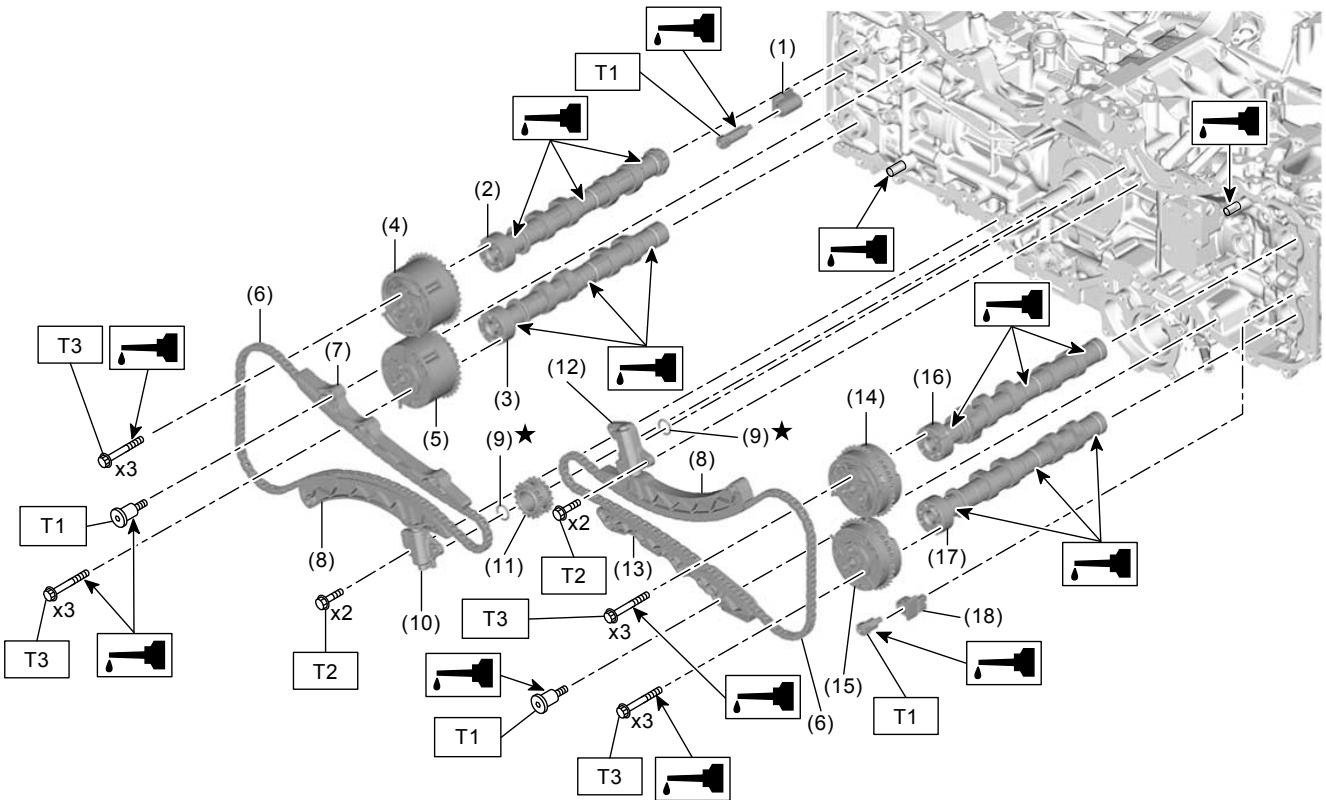
(4) O-ring

(9) O-ring

(5) Front oil seal

(10) O-ring

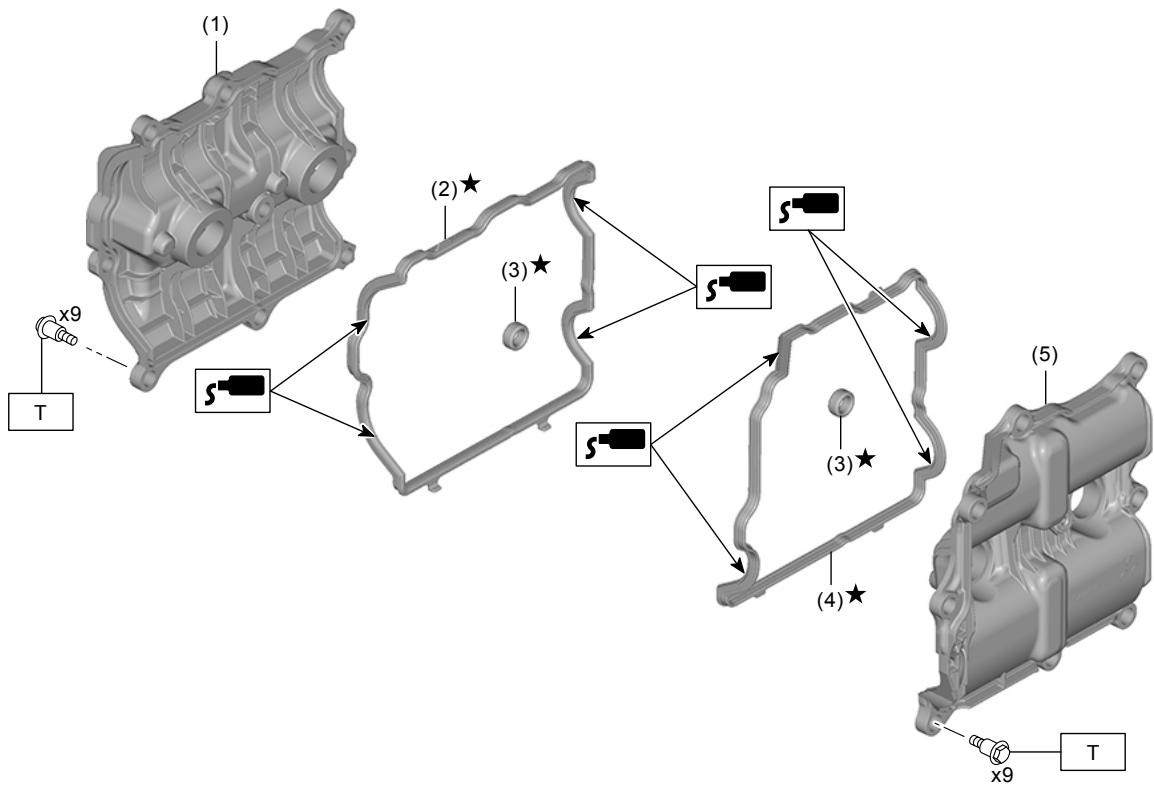
5. TIMING CHAIN & CAMSHAFT



ME-23182

- | | | |
|-----------------------------|------------------------------|--|
| (1) Side chain guide RH | (9) O-ring | (17) Exhaust camshaft LH |
| (2) Intake camshaft RH | (10) Chain tensioner RH | (18) Side chain guide LH |
| (3) Exhaust camshaft RH | (11) Crank sprocket | |
| (4) Intake cam sprocket RH | (12) Chain tensioner LH | |
| (5) Exhaust cam sprocket RH | (13) Chain guide LH | Tightening torque: N·m (kgf-m, ft-lb) |
| (6) Timing chain | (14) Intake cam sprocket LH | T1: 6.4 (0.7, 4.7) |
| (7) Chain guide RH | (15) Exhaust cam sprocket LH | T2: 8.5 (0.9, 6.3) |
| (8) Chain tension lever | (16) Intake camshaft LH | T3: 18 (1.8, 13.3) |

6. ROCKER COVER



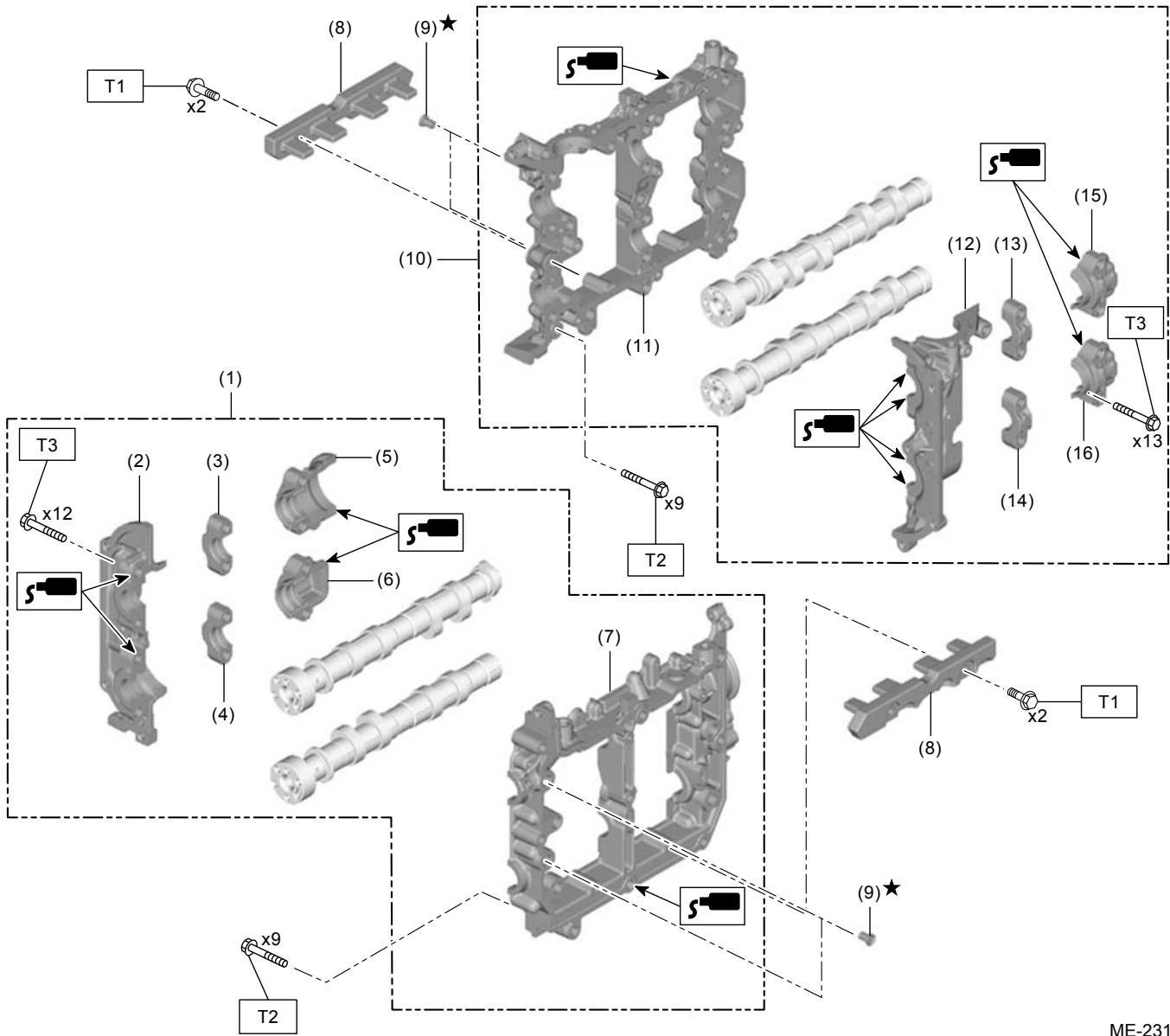
ME-23189

- | | |
|----------------------------|----------------------------|
| (1) Rocker cover RH | (4) Rocker cover gasket LH |
| (2) Rocker cover gasket RH | (5) Rocker cover LH |
| (3) Rocker cover gasket | |

Tightening torque: N·m (kgf-m, ft-lb)

T: [Ref. to
MECHANICAL\(H4DO\)>Rock
er Cover>INSTALLATION.](#)

7. CAM CARRIER

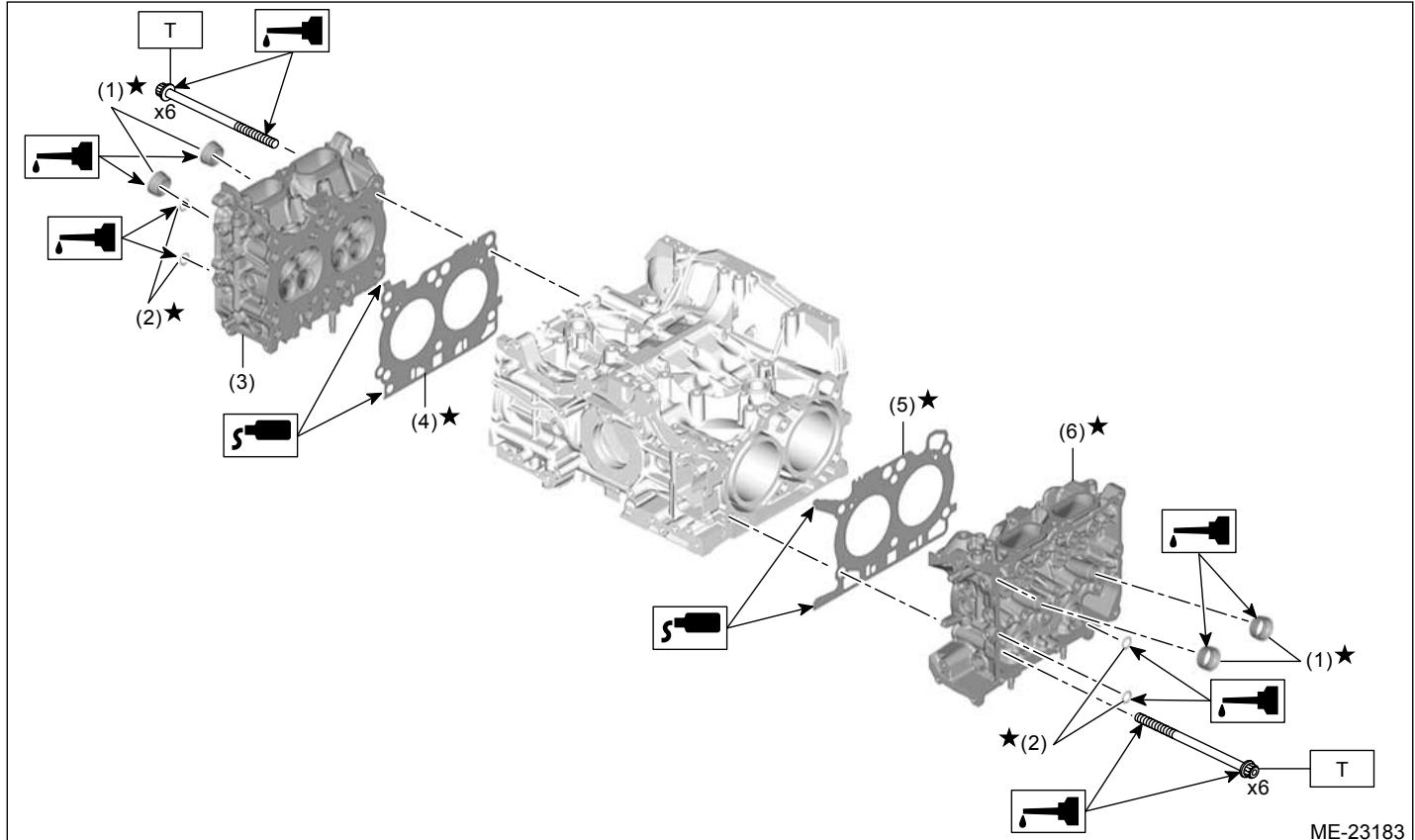


ME-23190

- | | | |
|------------------------------------|-------------------------------------|---|
| (1) Cam carrier ASSY RH | (8) Oil spacer | (15) Intake rear camshaft cap LH |
| (2) Front camshaft cap RH | (9) Filter | (16) Exhaust rear camshaft cap LH |
| (3) Intake center camshaft cap RH | (10) Cam carrier ASSY LH | |
| (4) Exhaust center camshaft cap RH | (11) Cam carrier LH | |
| (5) Intake rear camshaft cap RH | (12) Front camshaft cap LH | Tightening torque: N·m (kgf-m, ft-lb) |
| (6) Exhaust rear camshaft cap RH | (13) Intake center camshaft cap LH | T1: 6.4 (0.7, 4.7) |
| (7) Cam carrier RH | (14) Exhaust center camshaft cap LH | T2: Ref. to <u>MECHANICAL(H4DO)>Cam Carrier>INSTALLATION.</u> |

- T3: Ref. to MECHANICAL(H4DO)>Cam Carrier>ASSEMBLY.**

8. CYLINDER HEAD



(1) Spark plug pipe gasket

(4) Cylinder head gasket RH

(2) O-ring

(5) Cylinder head gasket LH

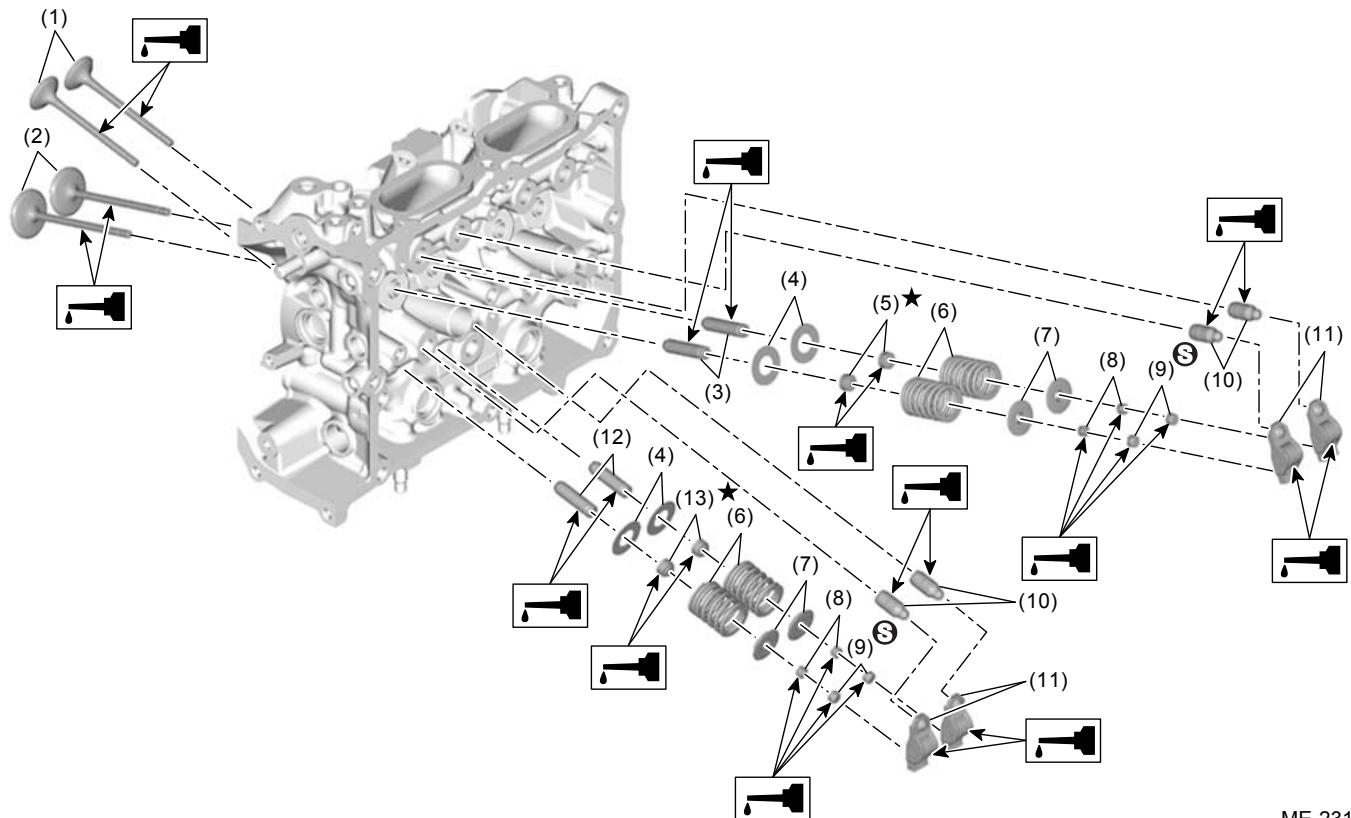
(3) Cylinder head RH

(6) Cylinder head LH

Tightening torque: N·m (kgf-m, ft-lb)

T: [Ref. to MECHANICAL\(H4DO\)>Cylinder Head>INSTALLATION.](#)

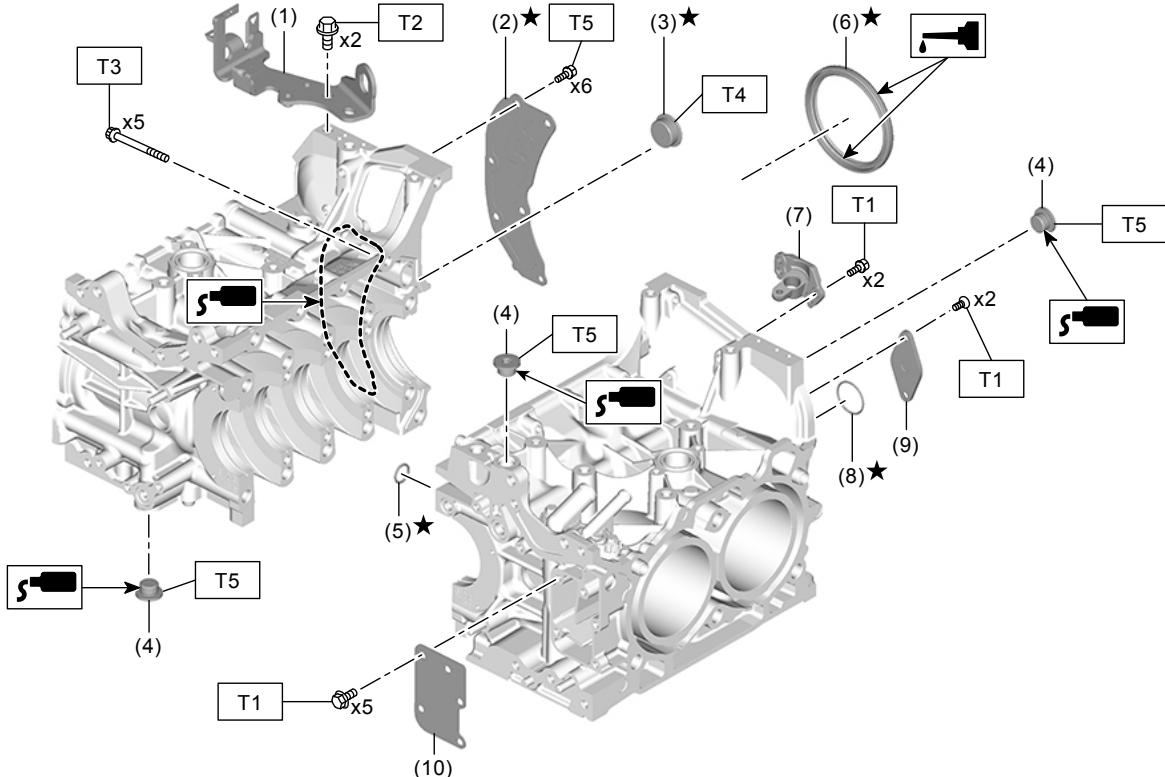
9. VALVE ASSEMBLY



ME-23184

- | | | |
|---------------------------|------------------------------|-----------------------------|
| (1) Exhaust valve | (6) Valve spring | (11) Roller rocker arm |
| (2) Intake valve | (7) Valve spring retainer | (12) Exhaust valve guide |
| (3) Intake valve guide | (8) Valve collet | (13) Exhaust valve oil seal |
| (4) Valve spring seat | (9) Valve shim | |
| (5) Intake valve oil seal | (10) Roller rocker arm pivot | |

10. CYLINDER BLOCK 1



ME-23185

(1) Engine rear hanger

(6) Rear oil seal

Tightening torque: N·m (kgf·m, ft-lb)

(2) Oil separator cover

(7) Crankshaft position sensor holder

T1: 6.4 (0.7, 4.7)

(3) Service hole plug

(8) O-ring

T2: 21 (2.1, 15.5)

(4) Main gallery plug

(9) Service hole cover

T3: 25 (2.5, 18.4)

(5) O-ring

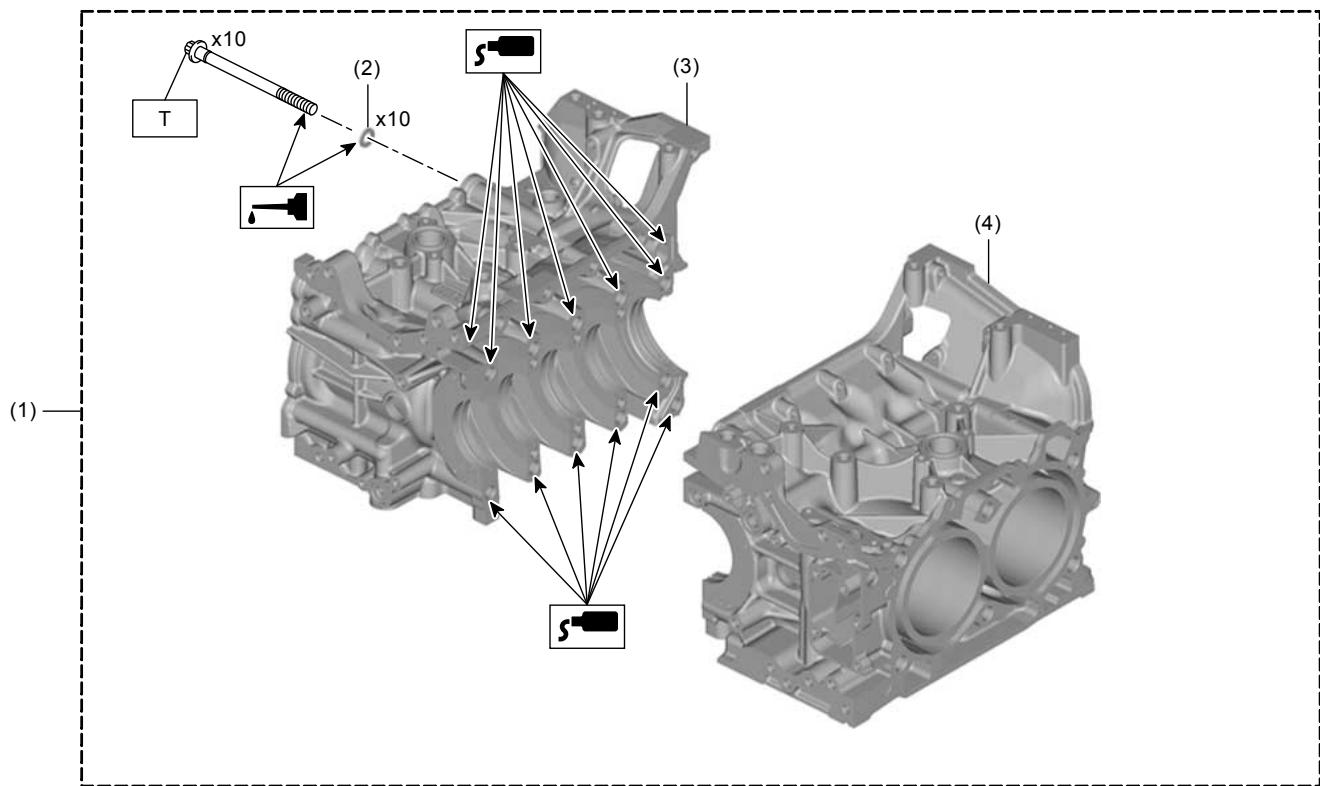
(10) Oil separator cover

T4: 70 (7.1, 51.6)

T5: [Ref. to](#)

[MECHANICAL\(H4DO\)>Cylinder Block>ASSEMBLY > CYLINDER BLOCK.](#)

11. CYLINDER BLOCK 2



ME-23186

(1) Cylinder block ASSY

(3) Cylinder block RH

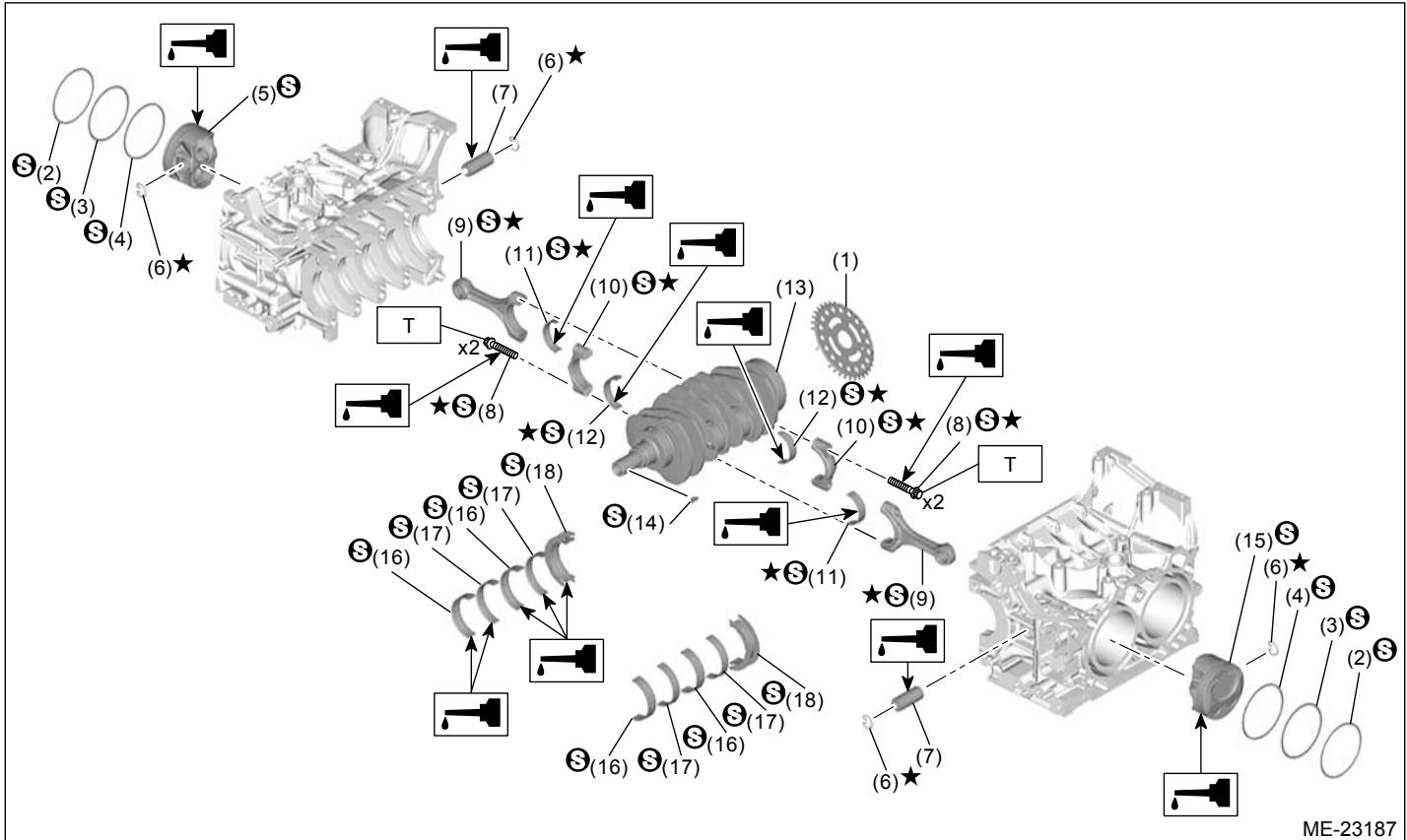
Tightening torque: N·m (kgf·m, ft-lb)

(2) Washer

(4) Cylinder block LH

T: [Ref. to
MECHANICAL\(H4DO\)>Cylinder
Block>INSTALLATION.](#)

12. CRANKSHAFT AND PISTON



ME-23187

- | | | |
|--|---|--------------------------------|
| (1) Crankshaft position sensor plate ^{*1} | (8) Connecting rod cap bolt ^{*2} | (15) Piston LH |
| (2) Top ring | (9) Connecting rod ^{*2} | (16) Crankshaft bearing #1, #3 |
| (3) Second ring | (10) Connecting rod cap ^{*2} | (17) Crankshaft bearing #2, #4 |
| (4) Oil ring | (11) Connecting rod bearing ^{*2} | (18) Crankshaft bearing #5 |
| (5) Piston RH | (12) Connecting rod bearing ^{*2} | |
| (6) Circlip | (13) Crankshaft | |
| (7) Piston pin | (14) Woodruff key | |

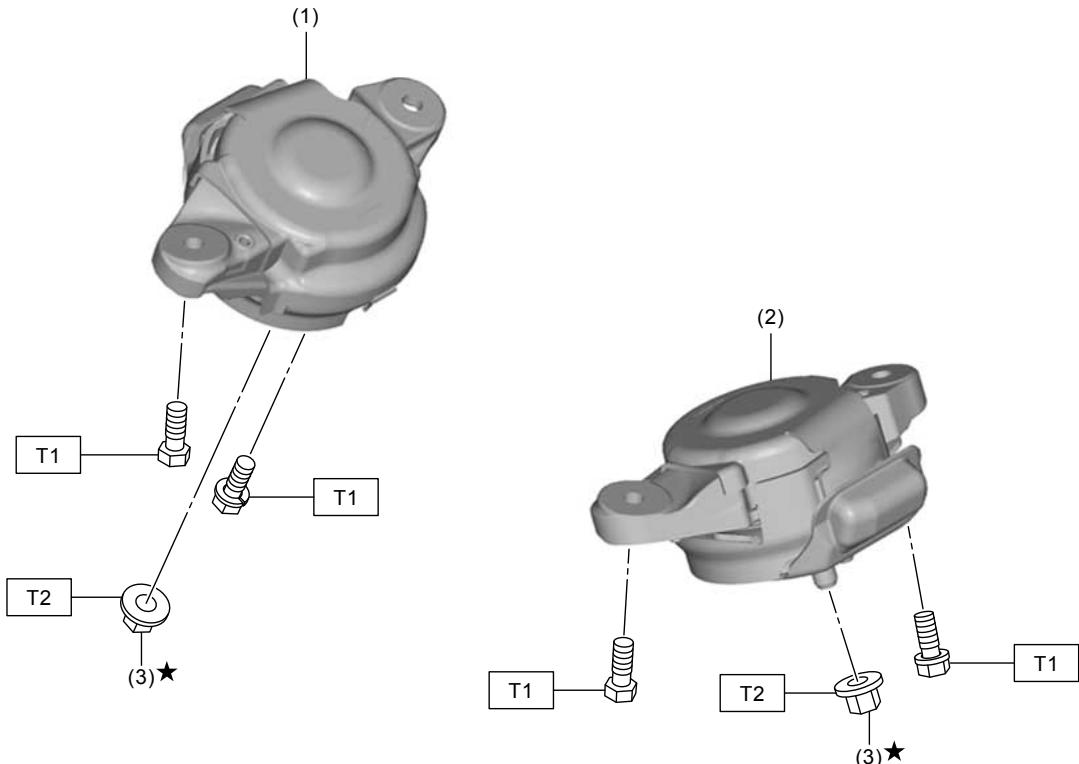
Tightening torque: N·m (kgf·m, ft-lb)

T: [Ref. to MECHANICAL\(H4DO\)>Cylinder Block>ASSEMBLY > CONNECTING ROD & CRANKSHAFT.](#)

^{*1}: Tightened together with the drive plate or flywheel.

^{*2}: When removing the connecting rod from the crankshaft, replace it with a new part. The connecting rod, connecting rod bearing, connecting rod cap, and connecting rod cap bolt are set parts.

13. ENGINE MOUNTING



ME-22777

(1) Front cushion rubber RH

(3) Nut

**Tightening torque: N·m (kgf-m,
ft-lb)**

(2) Front cushion rubber LH

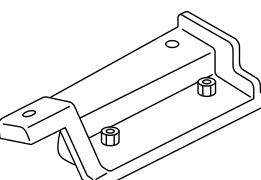
T1: 35 (3.6, 25.8)

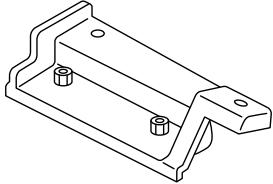
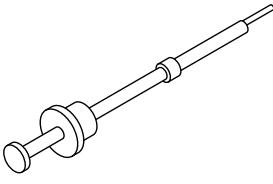
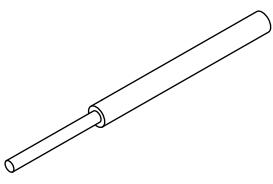
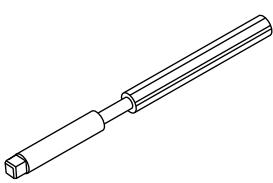
T2: 90 (9.2, 66.4)

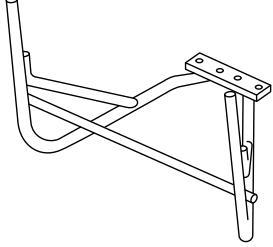
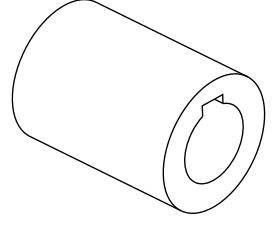
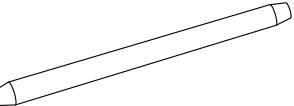
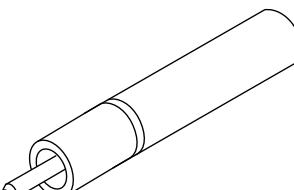
MECHANICAL(H4DO) > General Description

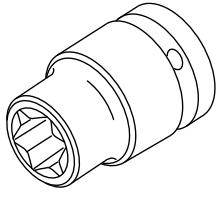
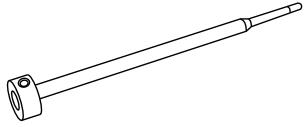
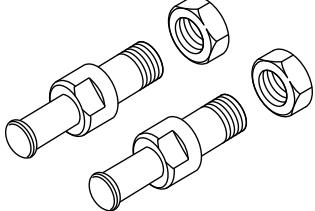
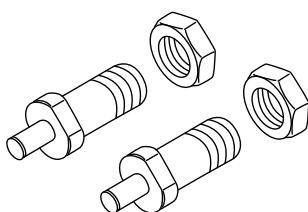
PREPARATION TOOL

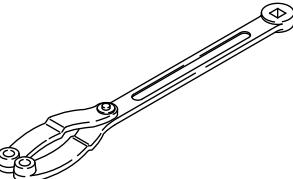
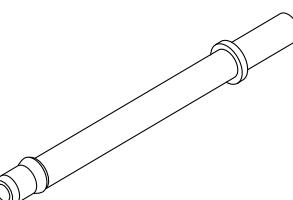
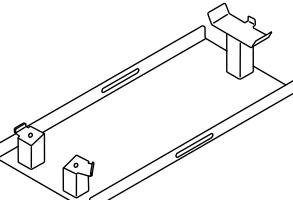
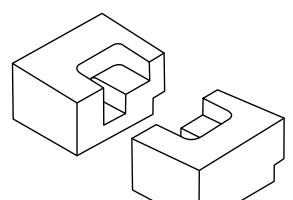
1. SUBARU SPECIAL TOOL

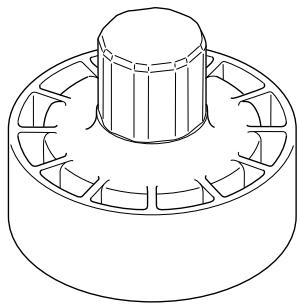
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-498457000	498457000	ENGINE STAND ADAPTER RH	<ul style="list-style-type: none"> Used for removing and installing the piston pin. Used together with ENGINE STAND (499817100).
	498457100	ENGINE STAND ADAPTER LH	<ul style="list-style-type: none"> Used for removing and installing the piston pin. Used together with ENGINE STAND

 ST-498457100			(499817100).
 ST-499097600	499097600	PISTON PIN REMOVER ASSY	<ul style="list-style-type: none"> Used for removing the piston pin. Used with the end part replaced with PISTON PIN REMOVER (18333AA000).
 ST-499765700	499765700	VALVE GUIDE REMOVER AND INSTALLER	Used for removing and installing valve guide.
 ST-499765900	499765900	VALVE GUIDE REAMER	Used for reaming valve guides.
	499817100	ENGINE STAND	<ul style="list-style-type: none"> Used for removing and installing the piston pin. Used together with ENGINE STAND ADAPTER RH (498457000) & LH (498457100).

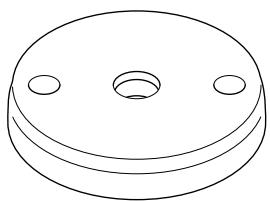
 ST-499817100			
 ST18252AA000	18252AA000	CRANKSHAFT SOCKET	Used for rotating crankshaft.
 ST18253AA000	18253AA000	PISTON PIN GUIDE	Used for installing the piston pin.
 ST18261AA010	18261AA010	VALVE OIL SEAL GUIDE	Used for press-fitting of intake valve oil seals and exhaust valve oil seals.
	18270KA010	SOCKET (E16)	<ul style="list-style-type: none"> • Used for removing and installing cam sprocket. • Used for removing and installing connecting rod.

 ST18270KA010			
 ST18333AA000	18333AA000	PISTON PIN REMOVER	<ul style="list-style-type: none"> Used for removing the piston pin. Used with the end part of PISTON PIN REMOVER ASSEMBLY (499097600) replaced.
 ST18334AA000	18334AA000	PULLEY WRENCH PIN SET	<ul style="list-style-type: none"> Used for removing and installing the crank pulley. Used together with PULLEY WRENCH (18355AA000).
 ST18334AA020	18334AA020	PULLEY WRENCH PIN SET	<ul style="list-style-type: none"> Used for rotating the intake cam sprocket LH. Used together with PULLEY WRENCH (18355AA000).
	18355AA000	PULLEY WRENCH	<ul style="list-style-type: none"> Used for removing and installing the crank pulley. Used for rotating the intake cam sprocket LH. Used together with PULLEY WRENCH PIN SET (18334AA000) or PULLEY WRENCH PIN SET (18334AA020).

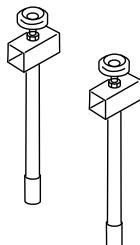
 ST18355AA000			
 ST18471AA000	18471AA000	FUEL PIPE ADAPTER	Used for inspecting the fuel pressure.
 ST18632AA010	18632AA010	STAND ASSY	Used for removing and installing the engine unit. (AT model)
 ST18632AA020	18632AA020	STAND ASSY	Used for removing and installing rocker cover.
	18657AA030	OIL SEAL INSTALLER	<ul style="list-style-type: none"> Used for installing the rear oil seal of engine. Used together with OIL SEAL GUIDE (18671AA020).



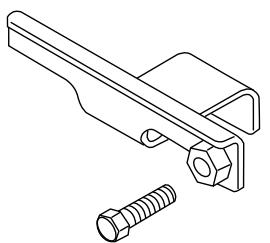
ST18657AA030



ST18671AA020



ST18679AA020



ST18750AA010

18671AA020

OIL SEAL GUIDE

- Used for installing the rear oil seal of engine.
- Used together with OIL SEAL INSTALLER (18657AA030).

18679AA020

ADJUSTER

- Used for removing and installing the engine mounting and rocker cover.
- Used together with ENGINE HANGER (99099AJ000).

18750AA010

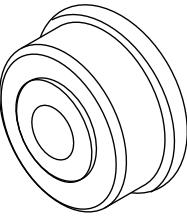
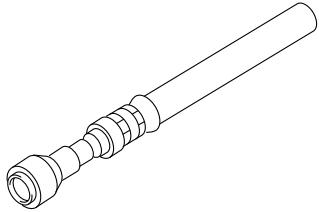
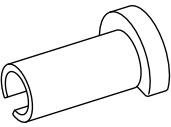
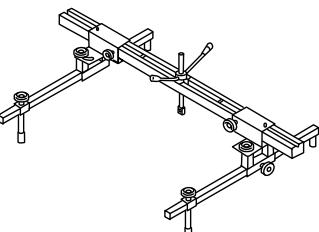
STOPPER SET

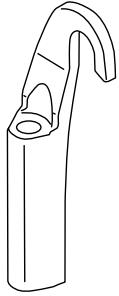
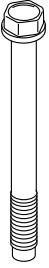
Used for removing and installing the engine unit.

41399FG020

SPECIAL TOOL B

Used for installing the front oil seal of engine.

	ST41399FG020		
	ST42075AG690	42075AG690 FUEL HOSE	<p>Used for inspecting the fuel pressure.</p> <p>Note: This is the SUBARU genuine part.</p>
	ST42099AE000	42099AE000 QUICK CONNECTOR RELEASE	<p>Used for removing FUEL HOSE (42075FG480).</p> <p>Note: FUEL HOSE (42075FG480) is used for checking the fuel pressure.</p>
	ST99099AJ000	99099AJ000 ENGINE HANGER	<ul style="list-style-type: none"> Used for removing and installing the engine mounting and rocker cover. Used together with ADJUSTER (18679AA020).
		<u>12281-38150</u> ENGINE HANGER NO.1	<ul style="list-style-type: none"> Used for removing and installing engine. Used for removing and installing the engine mounting. Used for removing and installing rocker cover. Used for removing and installing the

 ST1228138150			<p>cylinder block.</p> <ul style="list-style-type: none"> Used together with BOLT (<u>90119-14120</u>).
 ST9011914120	<u>90119-14120</u>	BOLT	<ul style="list-style-type: none"> Used for removing and installing engine. Used for removing and installing the engine mounting. Used for removing and installing rocker cover. Used for removing and installing the cylinder block. Used together with ENGINE HANGER NO.1 (<u>12281-38150</u>).
 STSSM4	—	SUBARU SELECT MONITOR 4	<p>Used for setting of each function and troubleshooting for electrical system.</p> <p>Note:</p> <ul style="list-style-type: none"> For detailed operation procedures, refer to "Help" of application. Used together with interface for Subaru Select Monitor (such as DST-i and DST-010).

2. OTHER

	REMARKS
Compression gauge	Used for measuring compression.
Vacuum gauge	Used for measuring intake manifold vacuum.
Fuel pressure gauge	Used for measuring fuel pressure.
Thickness gauge	Used for various inspections.
Rubber sheet Width × Height × Thickness Approx. 45 mm × approx. 45 mm × approx. 5 mm (Approx. 1.77 in × Approx. 1.77 in × Approx. 0.20 in)	<p>Used for removing and installing the engine unit. (AT model)</p> <p>Note:</p> <p style="border: 1px solid blue; padding: 5px;">Used by attaching to STAND ASSY (18632AA010) with double sided tape, etc.</p>
	Used for removing and installing the engine mounting and rocker cover.

Shackle	<p>Note:</p> <p>Load capacity: Use a shackle with a load capacity of 250 kg (551 lb) or more.</p>
Engine stand	Used for disassembling and assembling engine.
Angle gauge	Used for angle tightening.
Valve spring compressor	Used for removing and installing valve spring.
Piston ring compressor	Used for installing the piston into the cylinder block.

MECHANICAL(H4DO) > Compression

INSPECTION

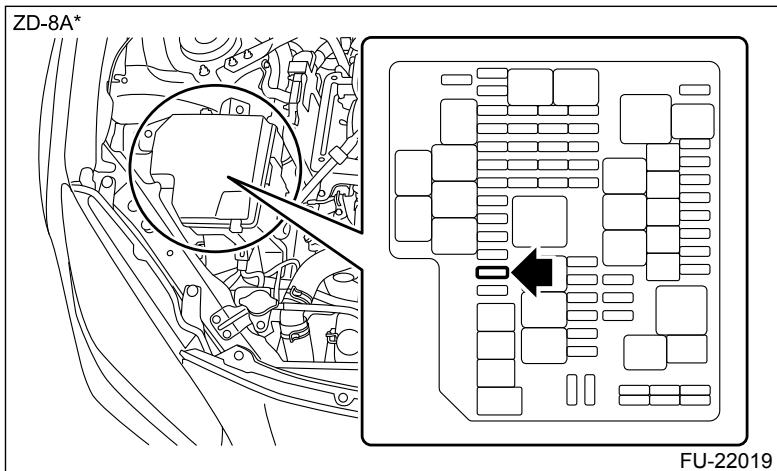
Caution:

After warming-up, engine becomes very hot. Be careful not to burn yourself during measurement.

Note:

- Before checking the compression pressure, the compression condition of each cylinder can be confirmed as a guide by using the cylinder compression measurement mode in Subaru Select Monitor.  [Ref. to ENGINE \(DIAGNOSTICS\)\(H4DO\)>Active Test>OPERATION.](#)
- In the cylinder compression measurement mode, the compression condition is judged by each cylinder speed. The high speed cylinder has low compression pressure and low speed cylinder has high compression pressure.

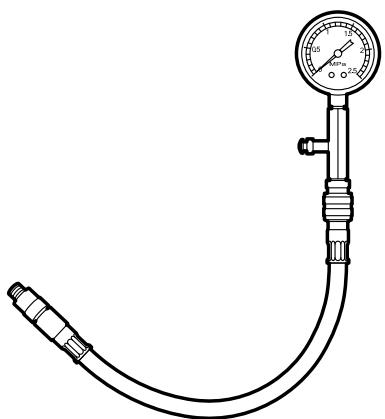
1. After warming-up the engine, turn the ignition switch to OFF.
2. Make sure that the battery is fully charged.
3. Check the starter motor for satisfactory performance and operation.
4. Remove the fuse of fuel pump from main fuse box.



5. Start the engine and run it until it stalls.
6. After the engine stalls, crank it for five more seconds.
7. Turn the ignition switch to OFF.
8. Remove all spark plugs.  [Ref. to IGNITION\(H4DO\)>Spark Plug>REMOVAL.](#)
9. Install the compression gauge to the spark plug hole.

Note:

When using a screw-in type compression gauge, the screw should be less than 25 mm (0.98 in) long.



ME-22789

- 10.** Connect the connectors to the ECM in numerical order as shown in the figure.

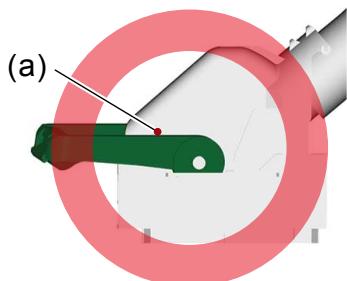
Caution:

To prevent damage to the connector, when connecting the connector, insert the connector straight in until it stops, and while maintaining the position, lock the lever.

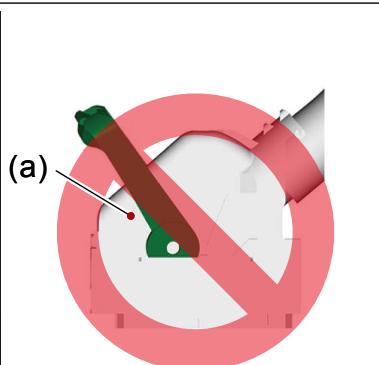
Note:

When connecting the connector, check that the lever is located at the position shown in the figure (position beyond the lock portion (a)).

SK-5CJ



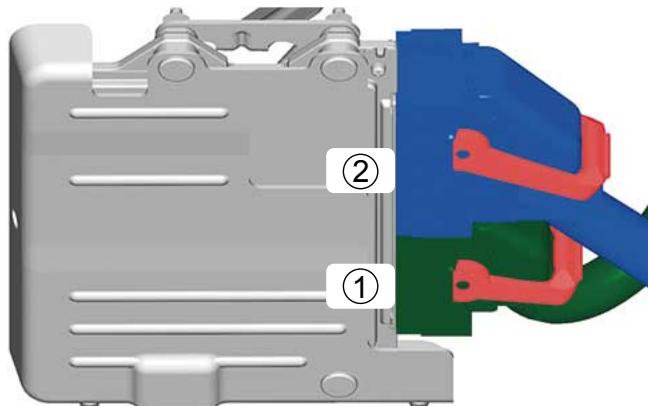
○=OK



⊖=NG

ME-22837

ZD-8A*



ME-23191

- 11.** Connect the ground terminal to the battery sensor. Ref. to REPAIR CONTENTS>NOTE > BATTERY.

- 12.** Turn the ignition switch to ON.

13. Depress the accelerator pedal to full throttle.

14. Crank the engine by starter motor and read the value when the needle of the compression gauge becomes stable.

Note:

- Perform at least two measurements per cylinder, and make sure that the values are correct.
- If the compression pressure is out of the standard value, check or adjust the pistons, valves and cylinders.

Compression pressure:

At 200 – 300 r/min

Standard

1,390 – 1,735 kPa (14 – 18 kgf/cm², 202 – 252 psi)

Difference between cylinders

100 kPa (1 kgf/cm², 14 psi) or less

15. After inspection, install the related parts in the reverse order of removal.

Note:

When compression pressure is checked, the malfunction indicator light illuminates and DTCs may be stored in ECM. When the malfunction indicator light has illuminated, clear the memory.  [Ref. to COMMON \(DIAGNOSTICS\)>Clear memory>OPERATION.](#)

MECHANICAL(H4DO) > Idle Speed

INSPECTION

- 1.** Before checking the idle speed, check the following item:
 - (1) Check the air cleaner element is free from clogging, ignition timing is correct, spark plugs are in good condition, and hoses are connected properly.
 - (2) Check the malfunction indicator light does not illuminate.
- 2.** Warm up the engine.
- 3.** Read the engine idle speed using Subaru Select Monitor.  [Ref. to ENGINE \(DIAGNOSTICS\)](#).
[\(H4DO\)>Data Monitor>OPERATION.](#)

Note:

- **Idle speed cannot be adjusted manually, because the idle speed is automatically adjusted.**
- **If idle speed is out of standard, refer to the basic diagnostic procedure of "ENGINE (DIAGNOSTICS)".**  [Ref. to ENGINE \(DIAGNOSTICS\)\(H4DO\)>Basic Diagnostic Procedure.](#)

(1) Check the idle speed when no-loaded. (Headlight, blower fan, rear defroster, radiator fan, A/C etc. are OFF)

Idle speed (No load, and for AT model, select lever in "P" or "N" range. For MT model, gear shift lever in neutral position.):

AT model

Standard

700±50 r/min

MT model

Standard

650±50 r/min

(2) Check the idle speed when loaded. (Turn the A/C switch to ON and operate the compressor for at least one minute before measurement.)

Idle speed (A/C ON, and for AT model, select lever in "P" or "N" range. For MT model, gear shift lever in neutral position.):

Standard

700 — 870±50 r/min

MECHANICAL(H4DO) > Ignition Timing

INSPECTION

- 1.** Before checking the ignition timing, check the following item:
 - (1) Check the air cleaner element is free from clogging, spark plugs are in good condition, and hoses are connected properly.
 - (2) Check the malfunction indicator light does not illuminate.
- 2.** Warm up the engine.
- 3.** Read the ignition timing using Subaru Select Monitor.  [Ref. to ENGINE \(DIAGNOSTICS\)\(H4DO\)>Data Monitor>OPERATION.](#)

Note:

If the ignition timing is out of standard, refer to the basic diagnostic procedure of "ENGINE (DIAGNOSTICS)".  [Ref. to ENGINE \(DIAGNOSTICS\)\(H4DO\)>Basic Diagnostic Procedure.](#)

Ignition timing [BTDC/{r/min}]:

AT model

Standard

$13^\circ \pm 10^\circ / 700$

MT model

Standard

$12^\circ \pm 10^\circ / 650$

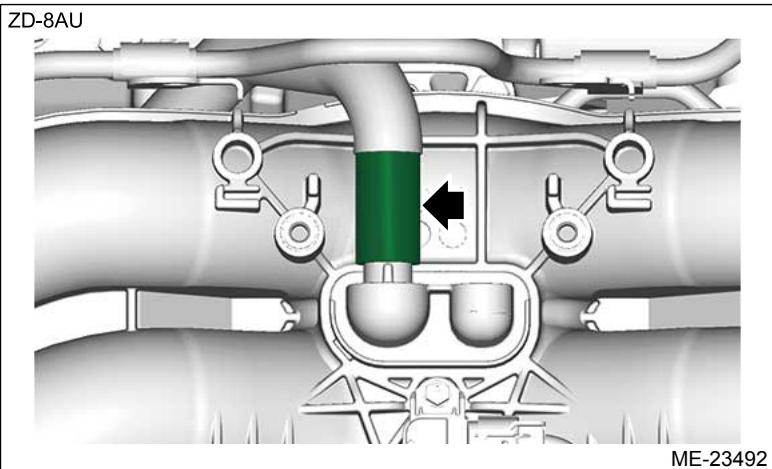
MECHANICAL(H4DO) > Intake Manifold Vacuum

INSPECTION

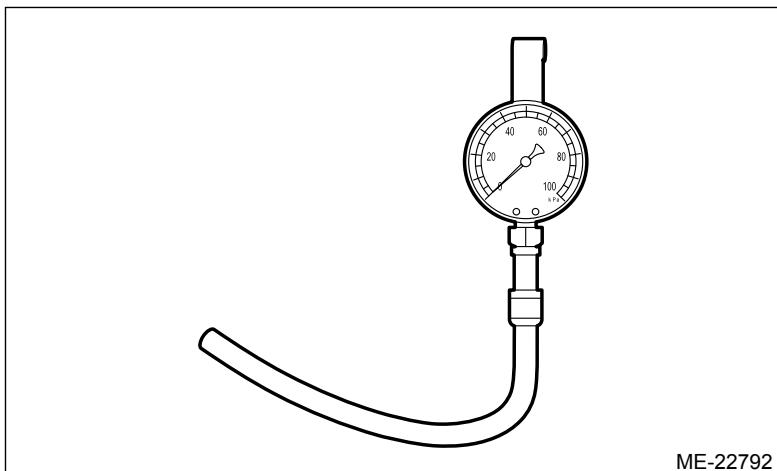
Caution:

After warming-up, engine becomes very hot. Be careful not to burn yourself at measurement.

1. Remove the collector cover. [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>Collector Cover>REMOVAL.](#)
2. Disconnect the PCV hose from intake manifold assembly.



3. Connect the vacuum gauge to the vacuum hose.



4. Warm up the engine.
5. Keep the engine at idle speed and read the vacuum gauge indication.

Note:

Condition of engine inside can be diagnosed by observing the behavior of the vacuum gauge needle as described in table below.

Intake manifold vacuum (A/C is at idling, A/C OFF):

Standard

-73.4 kPa (-550 mmHg, -21.68 inHg) or more

Diagnosis of engine condition by inspection of intake manifold vacuum

Vacuum gauge needle behavior

Possible engine condition

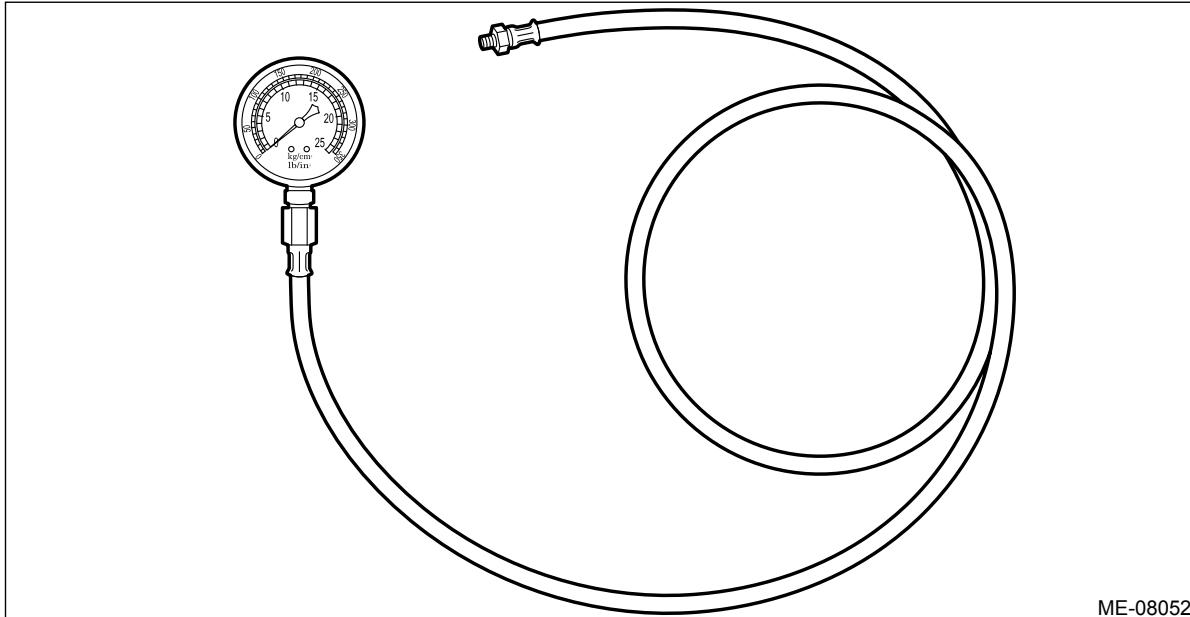
1. Needle is steady but lower than standard value. This tendency becomes more evident as engine temperature rises.	Leakage around intake manifold gasket, disconnection or damage of vacuum hose
2. Needle intermittently drops below the standard value.	Leakage around cylinder
3. Needle drops suddenly and intermittently from the standard value.	Sticky valve
4. When engine speed is gradually increased, needle begins to vibrate rapidly at certain speed, and then vibration increases as engine speed increases.	Weak or broken valve springs
5. Needle vibrates above and below the standard value in narrow range.	Defective ignition system

6. After inspection, install the related parts in the reverse order of removal.

MECHANICAL(H4DO) > Engine Oil Pressure

INSPECTION

1. Disconnect the ground terminal from battery sensor.  [Ref. to REPAIR CONTENTS>NOTE > BATTERY.](#)
2. Remove the oil pressure switch.  [Ref. to LUBRICATION\(H4DO\)>Oil Pressure Switch>REMOVAL.](#)
3. Install the oil pressure gauge to the installation area for the oil pressure switch of the chain cover.



4. Connect the ground terminal to battery sensor.  [Ref. to REPAIR CONTENTS>NOTE > BATTERY.](#)
5. Start the engine, and check the oil pressure.

Note:

- Standard value is based on an engine oil temperature of 80°C (176°F).
- If the oil pressure is out of the specification, check oil pump, oil filter and lubrication line.  [Ref. to LUBRICATION\(H4DO\)>Symptoms and causes>INSPECTION.](#)
- If the oil pressure warning light is ON and oil pressure is within standard, check the oil pressure system.  [Ref. to LUBRICATION\(H4DO\)>Oil Pressure System>INSPECTION.](#)

Engine oil pressure:

AT model

While idling (no load and select lever in "P" or "N" range)

Standard

44 kPa (0.4 kg/cm², 6 psi) or more

At 3,000 r/min

Standard

234 kPa (2.4 kg/cm², 34 psi) or more

MT model

While idling (no load and gear shift lever in neutral position)

Standard

39 kPa (0.4 kg/cm², 6 psi) or more

At 3,000 r/min

Standard

234 kPa (2.4 kg/cm², 34 psi) or more

- 6.** After inspection, install the related parts in the reverse order of removal.

INSPECTION

1. PORT INJECTION SIDE

1. Release the fuel pressure.  Ref. to FUEL INJECTION (FUEL SYSTEMS)(H4DO)>Fuel>PROCEDURE > [RELEASE OF FUEL PRESSURE](#).

2. Open the fuel filler lid and remove the fuel filler cap.

Note:

This operation is required to release the inner pressure of the fuel tank.

3. Disconnect the fuel delivery tube (port injection side) from the fuel pipe LH, and connect the fuel pressure gauge.

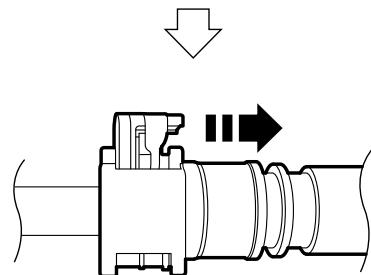
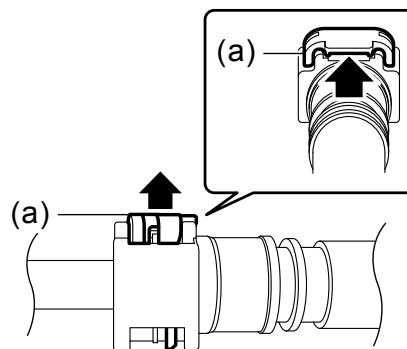
Caution:

- Be careful not to spill fuel.
- Catch the fuel from the tubes using a container or cloth.

(1) Open the fuel delivery tube clamp claw (B) securing the fuel delivery tube (port injection side) (A) and disconnect the quick connector on the fuel delivery tube (port injection side) (A) from the fuel pipe LH.

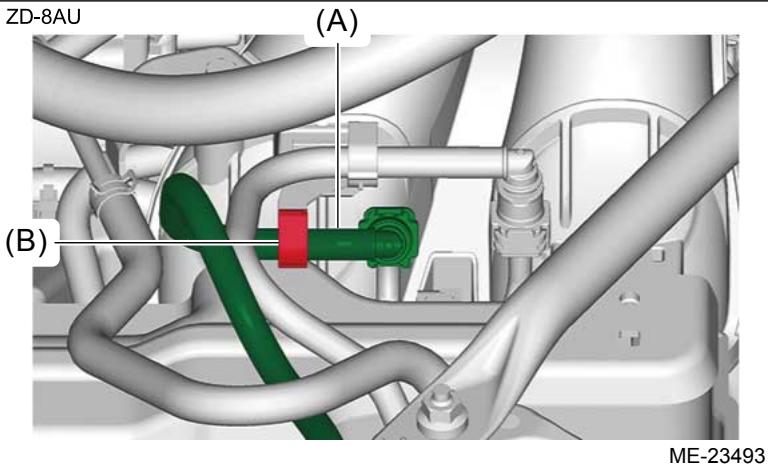
Note:

Disconnect the quick connector as shown in the figure.



ME-22794

(a) Slider



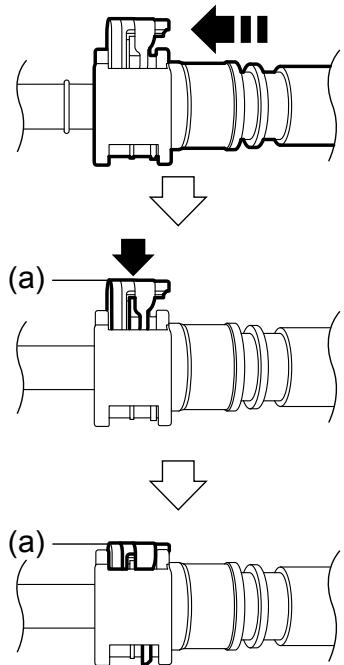
(2) Connect the fuel pressure gauge with ST1 and ST2.

Caution:

- Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the pipe.
- When connecting the quick connector of ST1, make sure to insert it all the way in.
- After connecting the ST1, pull the quick connector body of ST1 in the removal direction and then push it in the connecting direction, in order to check that the quick connector is securely connected. Always make sure to perform this confirmation ending up with a pushing in.
- When connecting the quick connector with slider, make sure to insert it all the way in before locking the slider.
- When it is difficult to lock the slider, check that the connector is fully inserted.
- After locking the slider, pull the quick connector itself to the disconnecting direction, and then push to the connecting direction in order to confirm secure connection. Always make sure to perform this confirmation ending up with a pushing in.

Note:

- ST1 is a SUBARU genuine part.
- When connecting the ST2 to the quick connector on the fuel delivery tube (port injection side), connect it as shown in the figure.



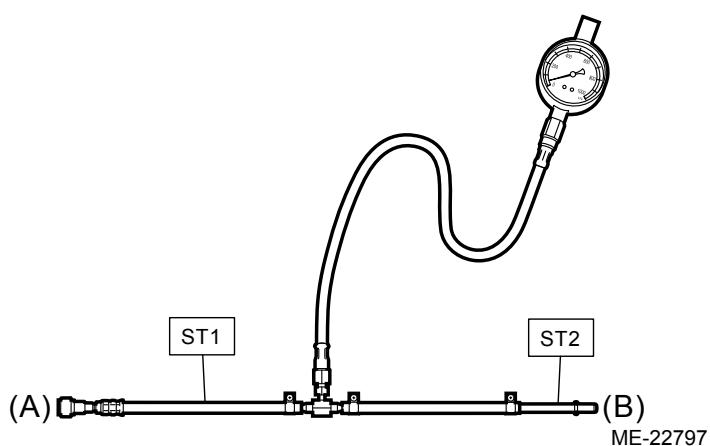
ME-22796

(a) Slider

Preparation tool:

ST1: FUEL HOSE (42075AG690)

ST2: FUEL PIPE ADAPTER (18471AA000)



(A) Fuel pipe LH side

(B) Fuel delivery tube (port
injection side) side

4. Start the engine, and check the fuel pressure.

Note:

- The fuel pressure gauge reading becomes 10 — 20 kPa (0.1 — 0.2 kg/cm², 1 — 3 psi) higher than standard values during high-altitude operations.
- Check or replace the fuel pump and fuel delivery line if the fuel pressure is out of the standard.

Fuel pressure:

Standard

360 — 470 kPa (3.7 — 4.8 kg/cm², 52 — 68 psi)

5. After inspection, install the related parts in the reverse order of removal.

Caution:

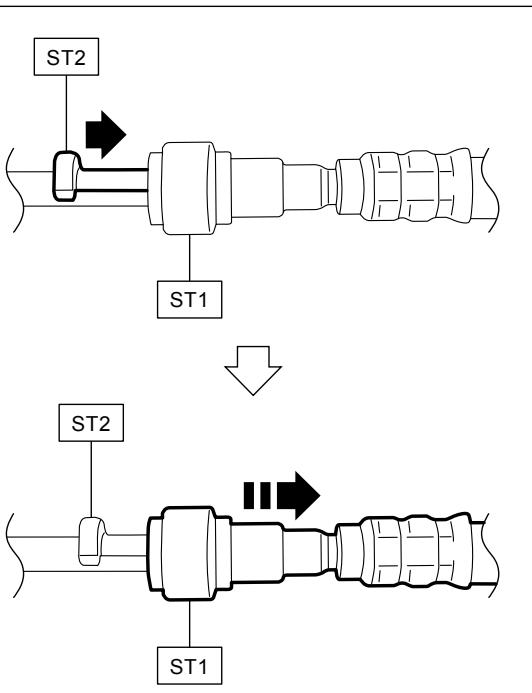
- Before removing the fuel pressure gauge, release the fuel pressure.
- Be careful not to spill fuel.
- Catch the fuel from hoses and tubes using a container or cloth.
- Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the pipe.
- When connecting the quick connector with slider, make sure to insert it all the way in before locking the slider.
- When it is difficult to lock the slider, check that the connector is fully inserted.
- After locking the slider, pull the quick connector itself to the disconnecting direction, and then push to the connecting direction in order to confirm secure connection. Always make sure to perform this confirmation ending up with a pushing in.

Note:

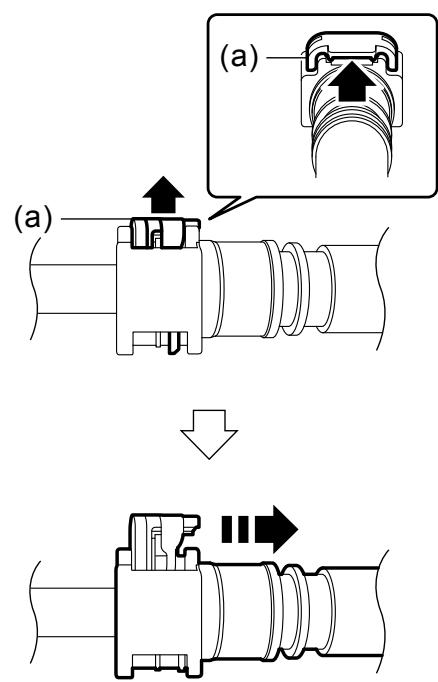
- When disconnecting the ST1, install the ST2 to the fuel pipe LH, and press the ST2 in the direction of arrow to disconnect the quick connector on the ST1.

Preparation tool:

ST2: QUICK CONNECTOR RELEASE (42099AE000)

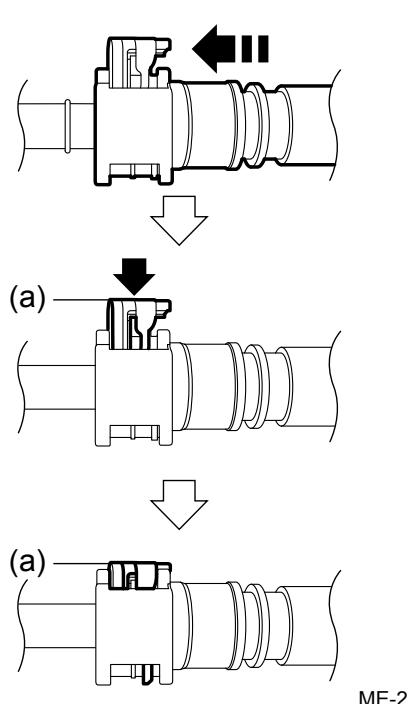


- Disconnect the quick connector on the fuel delivery tube (port injection side) as shown in the figure.



(a) Slider

- Connect the quick connector on the fuel delivery tube (port injection side) as shown in the figure.



(a) Slider

2. CYLINDER DIRECT INJECTION SIDE

1. Release the fuel pressure.  Ref. to FUEL INJECTION (FUEL SYSTEMS)(H4DO) > Fuel > PROCEDURE > RELEASING OF FUEL PRESSURE.

2. Open the fuel filler lid and remove the fuel filler cap.

Note:

This operation is required to release the inner pressure of the fuel tank.

3. Disconnect the fuel delivery tube (cylinder direct injection side) from the fuel delivery pipe assembly, and connect the fuel pressure gauge.

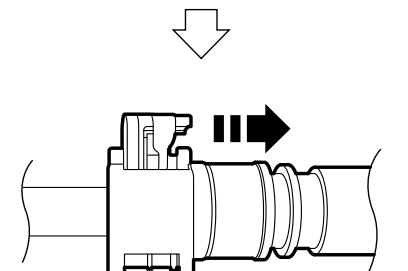
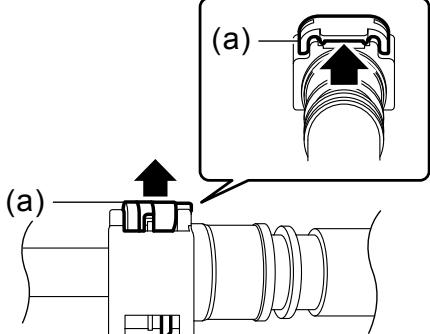
Caution:

- Be careful not to spill fuel.
- Catch the fuel from the tubes using a container or cloth.

(1) Open the fuel delivery tube clamp claw (B) securing the fuel delivery tube (cylinder direct injection side) (A) and disconnect the quick connector on the fuel delivery tube (cylinder direct injection side) (A) from the fuel delivery pipe assembly.

Note:

Disconnect the quick connector as shown in the figure.



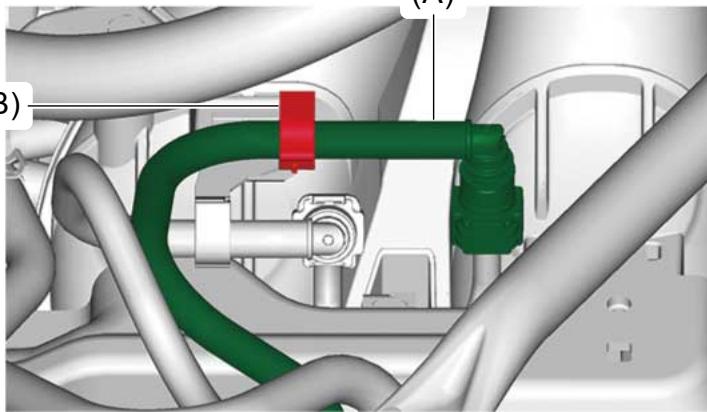
ME-22794

(a) Slider

ZD-8AU

(A)

(B)



ME-23494

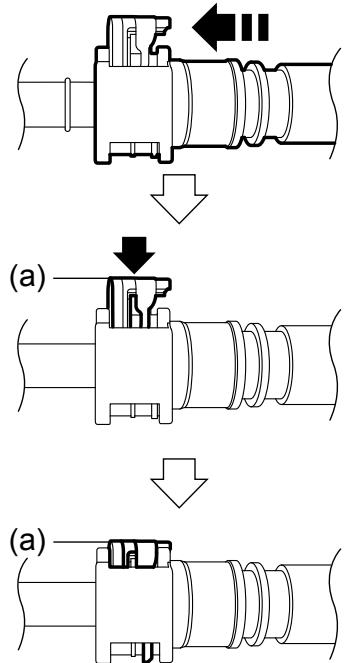
(2) Connect the fuel pressure gauge with ST1 and ST2.

Caution:

- Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the pipe.
- When connecting the quick connector of ST1, make sure to insert it all the way in.
- After connecting the ST1, pull the quick connector body of ST1 in the removal direction and then push it in the connecting direction, in order to check that the quick connector is securely connected. Always make sure to perform this confirmation ending up with a pushing in.
- When connecting the quick connector with slider, make sure to insert it all the way in before locking the slider.
- When it is difficult to lock the slider, check that the connector is fully inserted.
- After locking the slider, pull the quick connector itself to the disconnecting direction, and then push to the connecting direction in order to confirm secure connection. Always make sure to perform this confirmation ending up with a pushing in.

Note:

- ST1 is a SUBARU genuine part.
- When connecting the ST2 to the quick connector on the fuel delivery tube (cylinder direct injection side), connect it as shown in the figure.



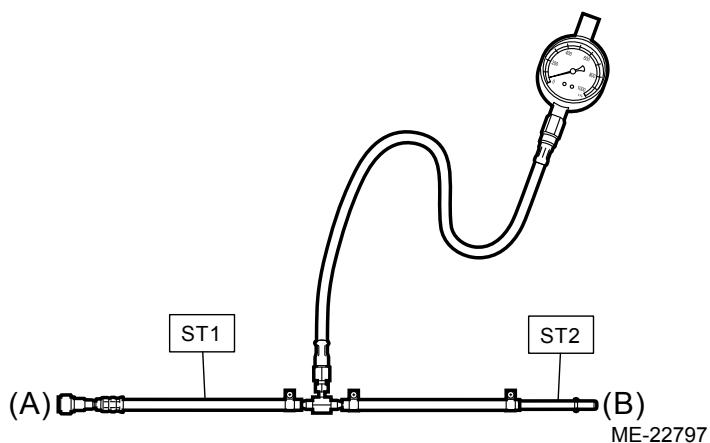
ME-22796

(a) Slider

Preparation tool:

ST1: FUEL HOSE (42075AG690)

ST2: FUEL PIPE ADAPTER (18471AA000)



(A) Fuel delivery pipe ASSY side (B) Fuel delivery tube (cylinder direct injection side) side

4. Start the engine, and check the fuel pressure.

Note:

- The fuel pressure gauge reading becomes 10 – 20 kPa (0.1 – 0.2 kg/cm², 1 – 3 psi) higher than standard values during high-altitude operations.
- Check or replace the fuel pump and fuel delivery line if the fuel pressure is out of the standard.

Fuel pressure:

Standard

360 – 470 kPa (3.7 – 4.8 kg/cm², 52 – 68 psi)

5. After inspection, install the related parts in the reverse order of removal.

Caution:

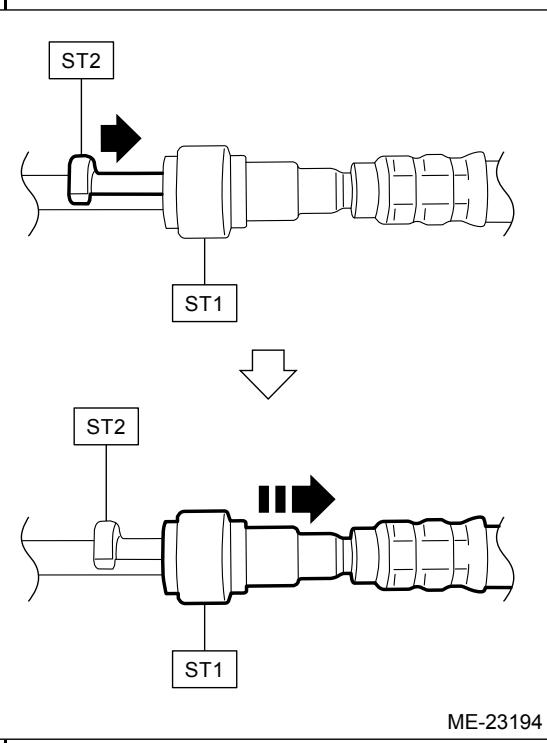
- Before removing the fuel pressure gauge, release the fuel pressure.
- Be careful not to spill fuel.
- Catch the fuel from hoses and tubes using a container or cloth.
- Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the pipe.
- When connecting the quick connector with slider, make sure to insert it all the way in before locking the slider.
- When it is difficult to lock the slider, check that the connector is fully inserted.
- After locking the slider, pull the quick connector itself to the disconnecting direction, and then push to the connecting direction in order to confirm secure connection. Always make sure to perform this confirmation ending up with a pushing in.

Note:

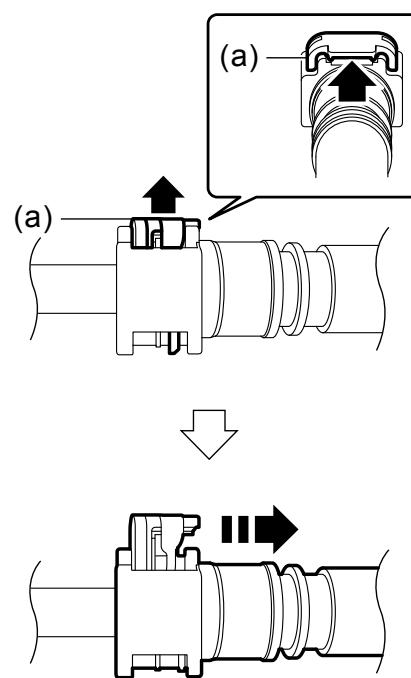
- When disconnecting the ST1, install the ST2 to the fuel delivery pipe assembly, and press the ST2 in the direction of arrow to disconnect the quick connector on the ST1.

Preparation tool:

ST2: QUICK CONNECTOR RELEASE (42099AE000)



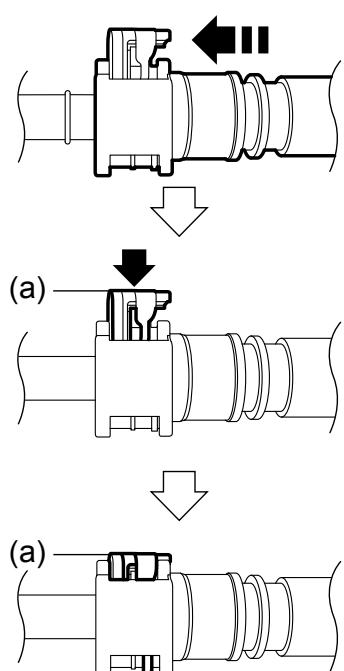
- Disconnect the quick connector on the fuel delivery tube (cylinder direct injection side) as shown in the figure.



ME-22794

(a) Slider

- Connect the quick connector on the fuel delivery tube (cylinder direct injection side) as shown in the figure.



ME-22796

(a) Slider

MECHANICAL(H4DO) > Cam Clearance

INSPECTION

1. WHEN TIMING CHAIN ASSEMBLY IS NOT REMOVED

Caution:

When working on the vehicle, be careful not to spill engine oil on the exhaust pipe. If engine oil is spilt onto the exhaust pipe, wipe it off with cloth to avoid emission of smoke or causing a fire.

Note:

Inspection of cam clearance should be performed while engine is cold.

1. When inspecting #1 and #3 cylinders

- (1) Remove the rocker cover RH.  [Ref. to MECHANICAL\(H4DO\)>Rocker Cover>REMOVAL > ROCKER COVER RH.](#)

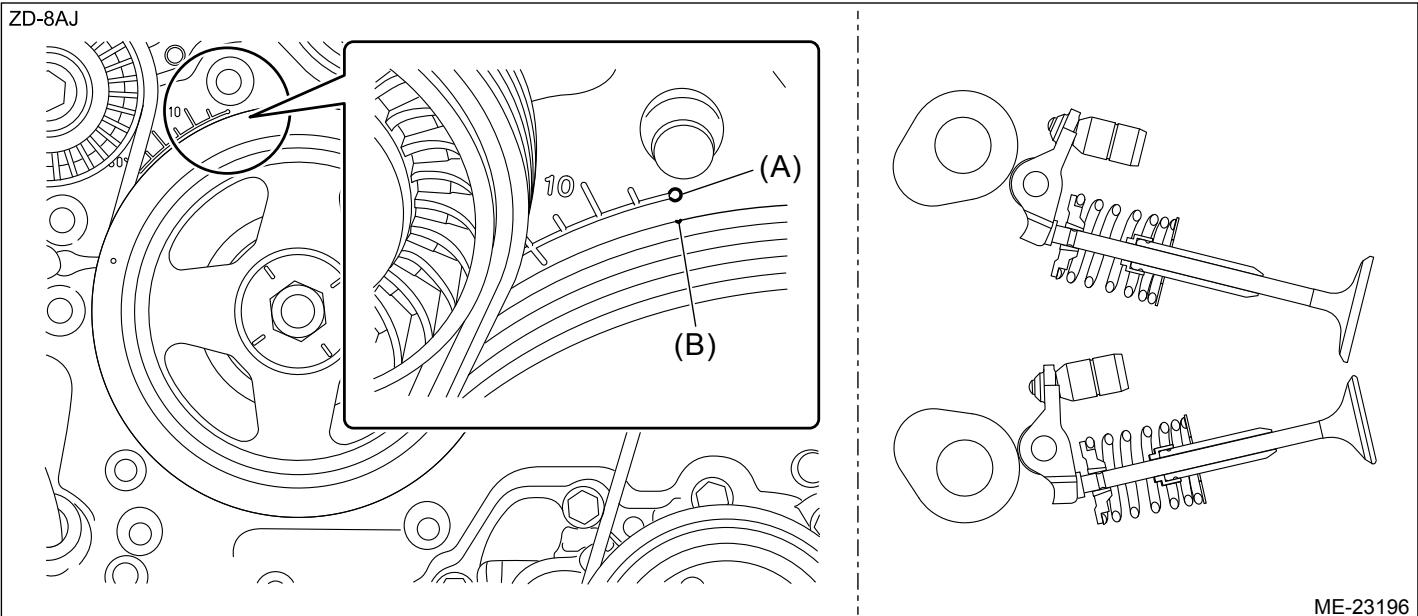
Note:

When working on the vehicle, place a suitable container under the vehicle.

- (2) Set #1 cylinder piston to top dead center of compression stroke by rotating the crank pulley clockwise using the socket wrench.

Note:

When the timing mark (B) on crank pulley is aligned to the 0° in timing gauge (A) on chain cover as shown in the figure, the #1 cylinder piston is located at TDC of compression stroke if the intake camshaft and exhaust camshaft does not depress the #1 cylinder intake side roller rocker arm (intake valve) and exhaust side roller rocker arm (exhaust valve). If roller rocker arm (valve) is depressed, turn the crank pulley by 360° in order to make #1 cylinder piston at TDC of compression stroke.



- (3) Check the cam clearance for #1 cylinder intake, #1 cylinder exhaust and #3 cylinder exhaust.

Note:

- Measure the roller surface of cam base circle and roller rocker arm using thickness gauge (A).
- If the measured value is out of standard, take notes of the value in order to adjust the cam clearance later on.

Cam clearance:

Intake

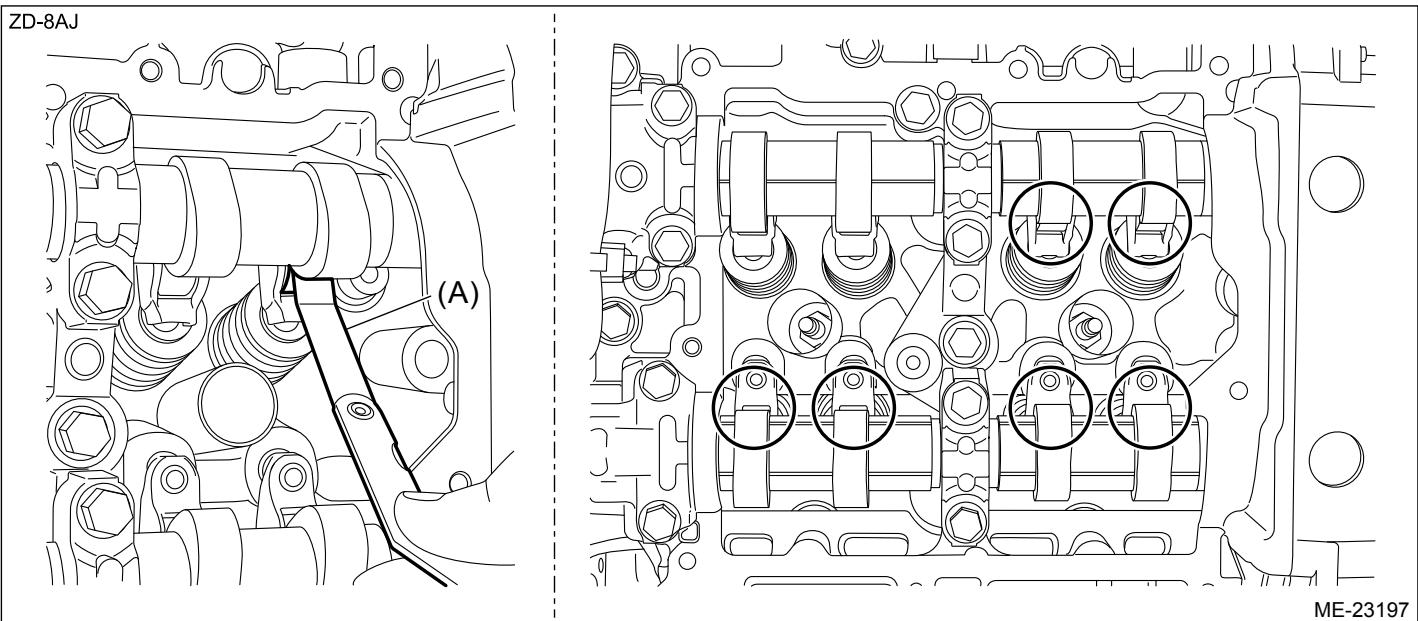
Standard

$0.13^{+0.02}_{-0.03}$ mm ($0.0051^{+0.0008}_{-0.0012}$ in)

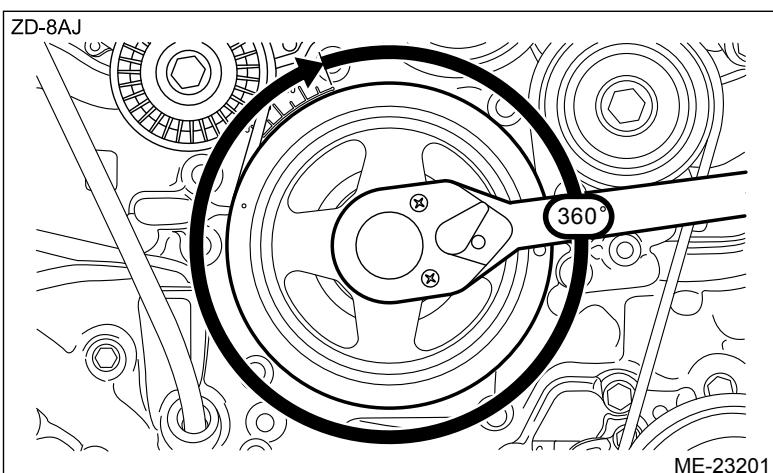
Exhaust

Standard

0.22 ± 0.02 mm (0.0087 ± 0.0008 in)



(4) Turn the crank pulley by 360°.



(5) Check the cam clearance of #3 cylinder intake.

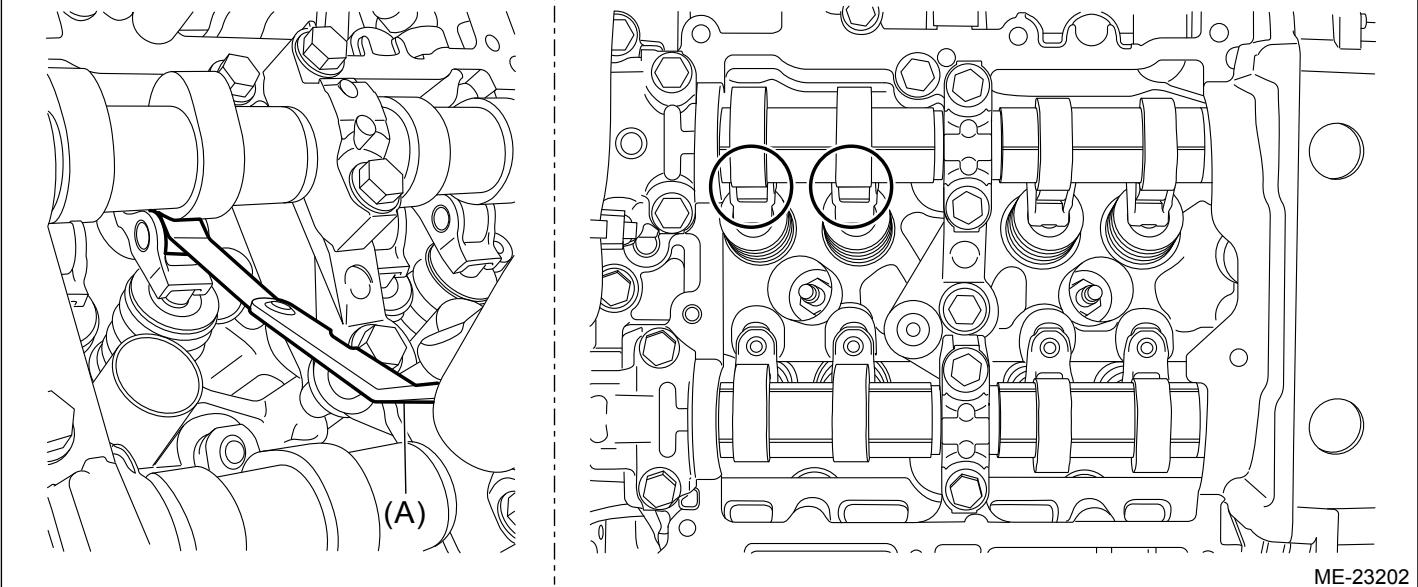
Note:

- Measure the roller surface of cam base circle and roller rocker arm using thickness gauge (A).
- If the measured value is out of standard, take notes of the value in order to adjust the cam clearance later on.

Cam clearance:**Standard**

$0.13^{+0.02}_{-0.03}$ mm ($0.0051^{+0.0008}_{-0.0012}$ in)

ZD-8AJ

**2. When inspecting #2 and #4 cylinders**

- (1) Remove the rocker cover LH. [Ref. to MECHANICAL\(H4DO\)>Rocker Cover>REMOVAL > ROCKER COVER LH.](#)

Note:

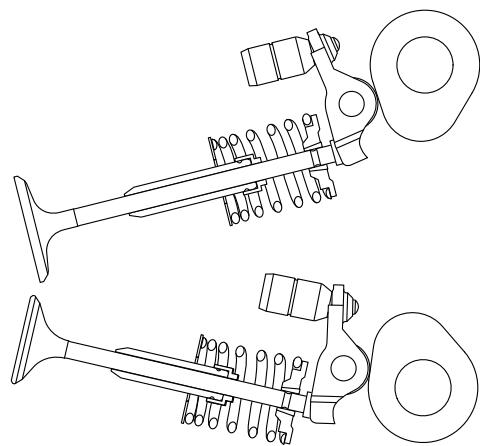
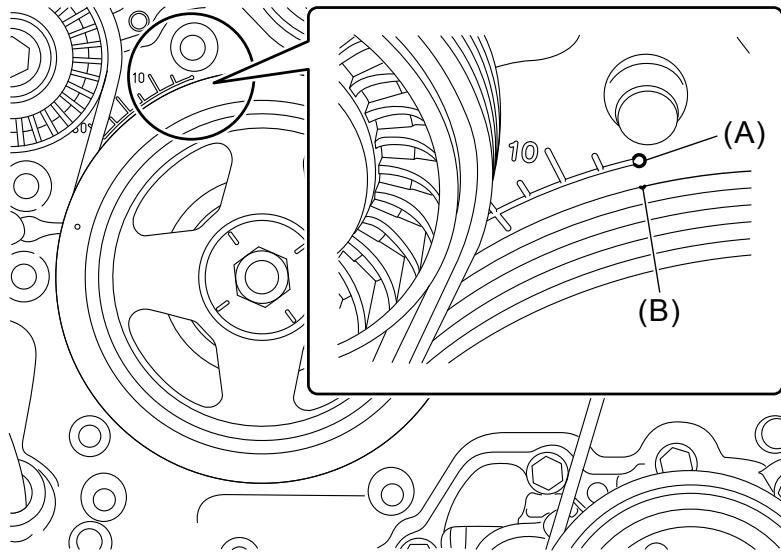
When working on the vehicle, place a suitable container under the vehicle.

- (2) Set #2 cylinder piston to top dead center of compression stroke by rotating the crank pulley clockwise using the socket wrench.

Note:

When the timing mark (B) on crank pulley is aligned to the 0° in timing gauge (A) on chain cover as shown in the figure, the #2 cylinder piston is located at TDC of compression stroke if the intake camshaft and exhaust camshaft does not depress the #2 cylinder intake side roller rocker arm (intake valve) and exhaust side roller rocker arm (exhaust valve). If roller rocker arm (valve) is depressed, turn the crank pulley by 360° in order to make #2 cylinder piston at TDC of compression stroke.

ZD-8AJ



ME-23203

(3) Check the cam clearance for #2 cylinder intake, #2 cylinder exhaust and #4 cylinder exhaust.

Note:

- **Measure the roller surface of cam base circle and roller rocker arm using thickness gauge (A).**
- **If the measured value is out of standard, take notes of the value in order to adjust the cam clearance later on.**

Cam clearance:

Intake

Standard

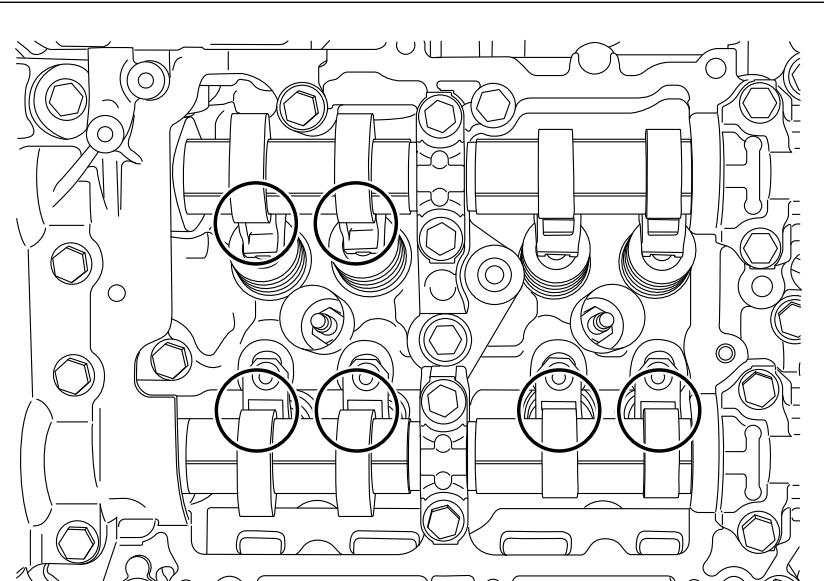
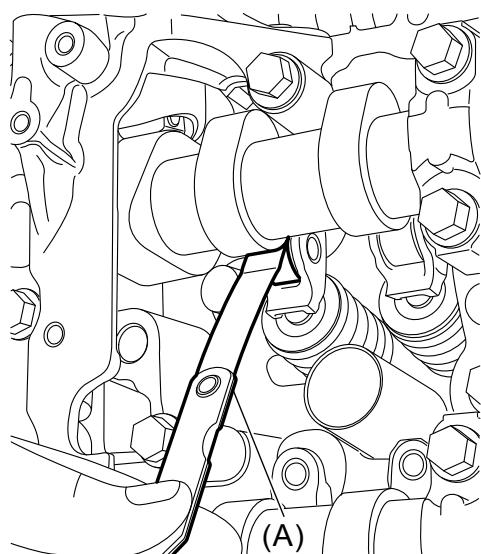
$0.13^{+0.02}_{-0.03}$ mm ($0.0051^{+0.0008}_{-0.0012}$ in)

Exhaust

Standard

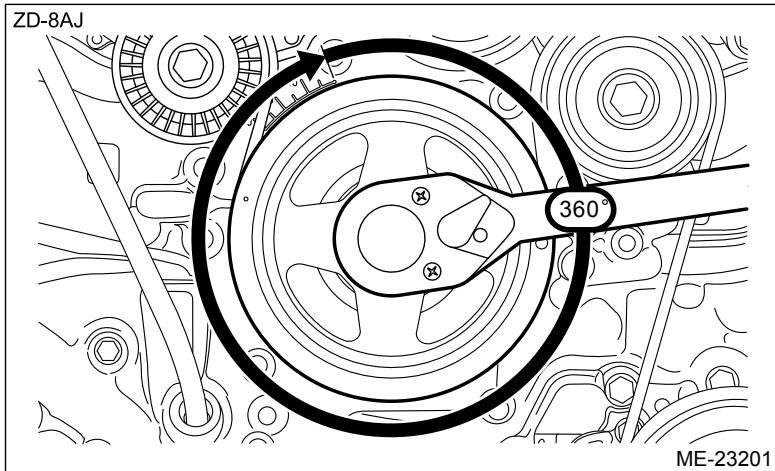
0.22 ± 0.02 mm (0.0087 ± 0.0008 in)

ZD-8AJ



ME-23204

(4) Turn the crank pulley by 360°.



(5) Check the cam clearance of #4 cylinder intake.

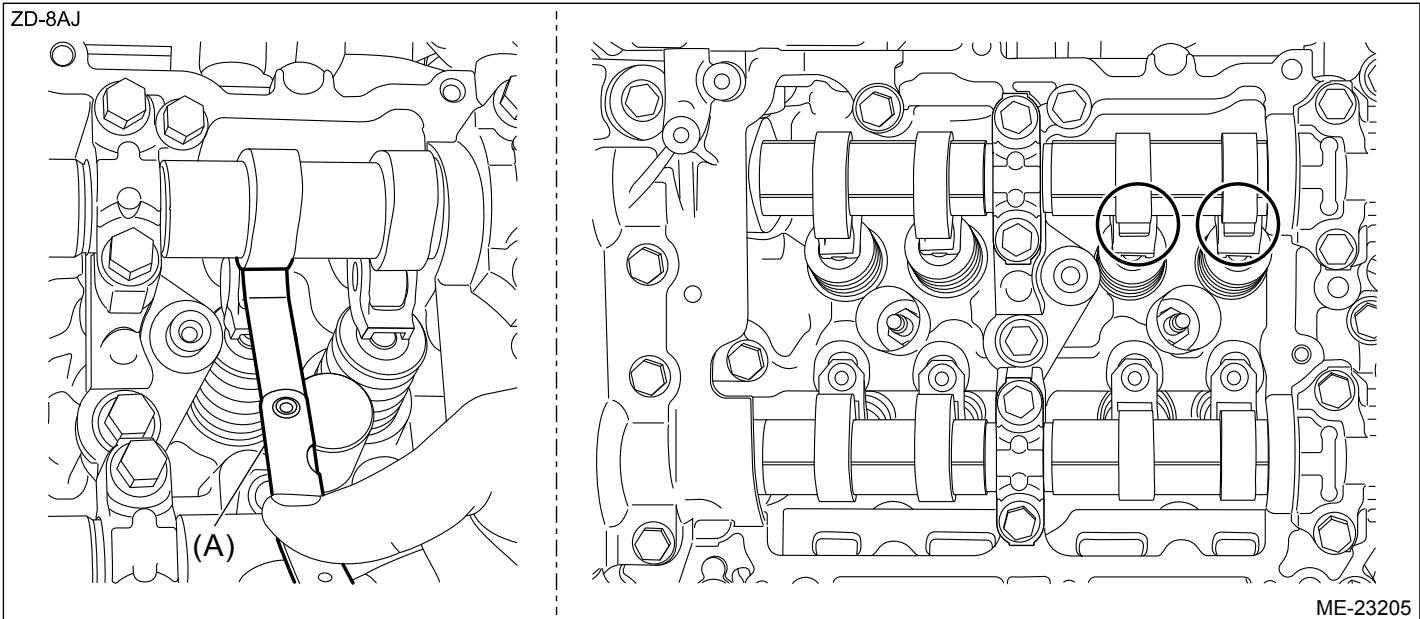
Note:

- **Measure the roller surface of cam base circle and roller rocker arm using thickness gauge (A).**
- **If the measured value is out of standard, take notes of the value in order to adjust the cam clearance later on.**

Cam clearance:

Standard

$$0.13^{+0.02}_{-0.03} \text{ mm } (0.0051^{+0.0008}_{-0.0012} \text{ in})$$



3. If necessary, adjust the cam clearance. [Ref. to MECHANICAL\(H4DO\)>Cam Clearance>ADJUSTMENT.](#)
4. After inspection, install the related parts in the reverse order of removal.

2. WHEN TIMING CHAIN ASSEMBLY IS REMOVED

Note:

Inspection of cam clearance should be performed while engine is cold.

1. When inspecting #1 and #3 cylinders

- (1) Remove the rocker cover RH.  Ref. to MECHANICAL(H4DO)>Rocker Cover>REMOVAL > ROCKER COVER RH.

Note:

When working on the vehicle, place a suitable container under the vehicle.

- (2) Check the #1 and #3 cylinder cam clearance.

Caution:

Intake and exhaust camshafts can be independently rotated with the timing chain removed. When the intake valve and exhaust valve lift at the same time, the valve heads contact each other and valve stem may bend. Do not turn it to the outside of range of zero lift (cam base circle position) (in range where it can be turned lightly by hand).

Note:

- For cam clearance inspection, adjust the cam base circle position so that the thickness gauge (A) can be inserted easily by hand turning the camshaft (cam sprocket) to be measured.
- Measure the roller surface of cam base circle and roller rocker arm using thickness gauge (A).
- If the measured value is out of standard, take notes of the value in order to adjust the cam clearance later on.

Cam clearance:

Intake

Standard

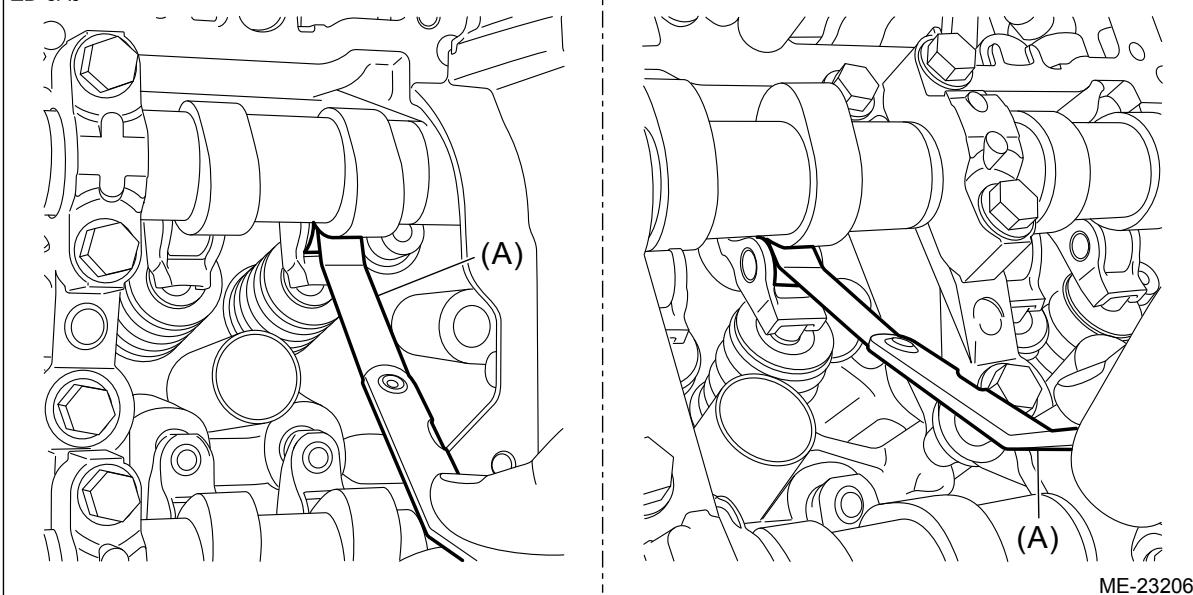
$0.13^{+0.02}_{-0.03}$ mm ($0.0051^{+0.0008}_{-0.0012}$ in)

Exhaust

Standard

0.22 ± 0.02 mm (0.0087 ± 0.0008 in)

ZD-8AJ



ME-23206

2. When inspecting #2 and #4 cylinders

- (1) Remove the rocker cover LH.  Ref. to MECHANICAL(H4DO)>Rocker Cover>REMOVAL > ROCKER COVER LH.

Note:

When working on the vehicle, place a suitable container under the vehicle.

- (2) Check the #2 and #4 cylinder cam clearance.

Caution:

Intake and exhaust camshafts can be independently rotated with the timing chain removed. When the intake valve and exhaust valve lift at the same time, the valve heads contact each other and valve stem may bend. Do not turn it to the outside of range of zero lift (cam base circle position) (in range where it can be turned lightly by hand).

Note:

- Because the intake camshaft is pressurized by the high-pressure fuel pump, it is almost impossible to turn the intake camshaft lightly by hand. Since the zero-lift position is adjusted at the removal of the timing chain LH, measure the cam clearance at that position.
- For cam clearance inspection on exhaust side, adjust the cam base circle position so that the thickness gauge (A) can be inserted easily by hand turning the exhaust camshaft (cam sprocket).
- Measure the roller surface of cam base circle and roller rocker arm using thickness gauge (A).
- If the measured value is out of standard, take notes of the value in order to adjust the cam clearance later on.

Cam clearance:

Intake

Standard

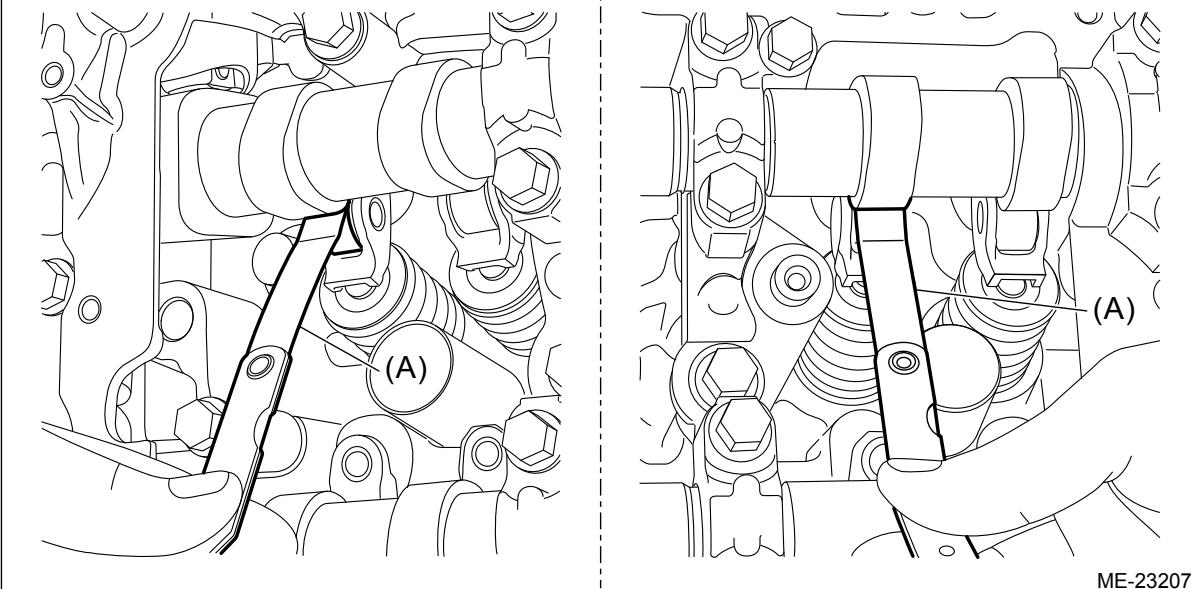
$0.13^{+0.02}_{-0.03}$ mm ($0.0051^{+0.0008}_{-0.0012}$ in)

Exhaust

Standard

0.22 ± 0.02 mm (0.0087 ± 0.0008 in)

ZD-8AJ



3. If necessary, adjust the cam clearance. [Ref. to MECHANICAL\(H4DO\)>Cam Clearance>ADJUSTMENT.](#)
4. After inspection, install the related parts in the reverse order of removal.

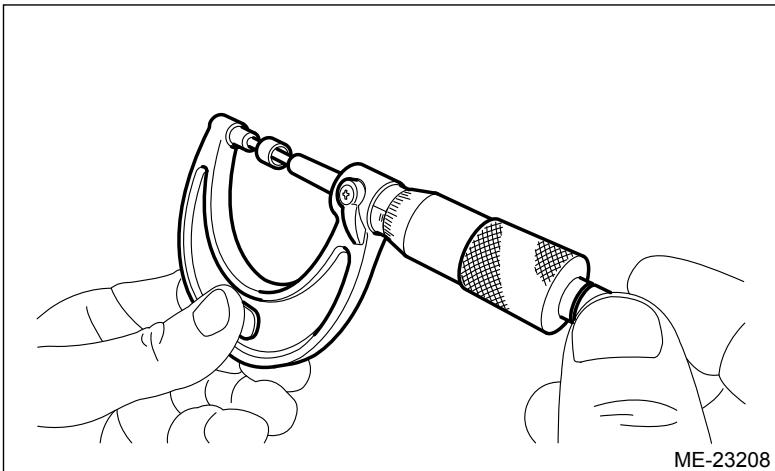
MECHANICAL(H4DO) > Cam Clearance

ADJUSTMENT

1. Remove the engine unit from the vehicle.  [Ref. to MECHANICAL\(H4DO\)>Engine Assembly>REMOVAL.](#)
2. Remove the chain cover.  [Ref. to MECHANICAL\(H4DO\)>Chain Cover>REMOVAL.](#)
3. When adjusting #1 and #3 cylinders
 - (1) Remove the cam carrier RH.  [Ref. to MECHANICAL\(H4DO\)>Cam Carrier>REMOVAL > CAM CARRIER RH.](#)
 - (2) Measure the thickness of valve shim using micrometer.

Note:

Measurement should be performed at a temperature of 20°C (68°F).



- (3) Select a valve shim of suitable thickness using the measured cam clearance and valve shim thickness.

Note:

Use a new valve shim.

Intake side: $S = T + 1.69 \times (V - 0.13 \text{ mm} (0.0051 \text{ in}))$

Exhaust side: $S = T + 1.87 \times (V - 0.22 \text{ mm} (0.0087 \text{ in}))$

S: Valve shim thickness required

V: Measured cam clearance

T: Current valve shim thickness

- (4) Install the cam carrier RH.  [Ref. to MECHANICAL\(H4DO\)>Cam Carrier>INSTALLATION > CAM CARRIER RH.](#)

- (5) Check all the cam clearance of RH side at this time. If the cam clearance is not within the standard value, repeat the procedure over again from step (1).

Note:

When the removing/installing of cam carrier RH has been performed, cam clearance may be outside the standard value. Checking of all cam clearance of RH side is necessary.

Refer to INSPECTION of "Cam Clearance" for the cam clearance inspection.  [Ref. to MECHANICAL\(H4DO\)>Cam Clearance>INSPECTION > WHEN TIMING CHAIN ASSEMBLY IS REMOVED.](#)

Cam clearance:

Intake

Standard

$0.13^{+0.02}_{-0.03}$ mm ($0.0051^{+0.0008}_{-0.0012}$ in)

Exhaust**Standard**

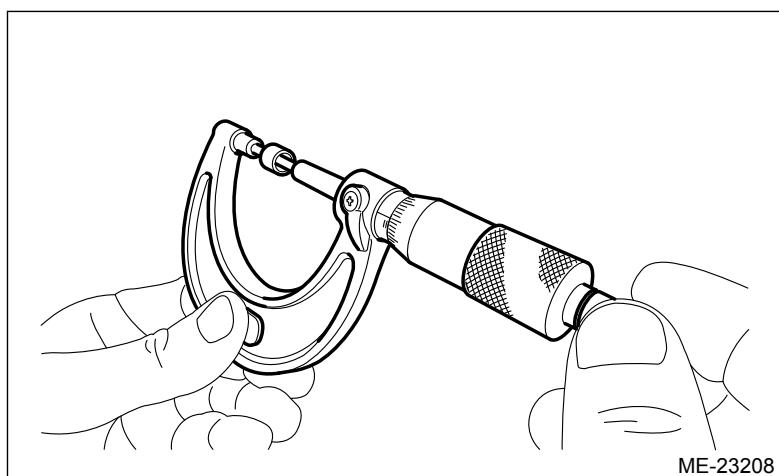
0.22 ± 0.02 mm (0.0087 ± 0.0008 in)

4. When adjusting #2 and #4 cylinders

- (1) Remove the cam carrier LH. [Ref. to MECHANICAL\(H4DO\)>Cam Carrier>REMOVAL > CAM CARRIER LH.](#)
- (2) Measure the thickness of valve shim using micrometer.

Note:

Measurement should be performed at a temperature of 20°C (68°F).



- (3) Select a valve shim of suitable thickness using the measured cam clearance and valve shim thickness.

Note:

Use a new valve shim.

Intake side: $S = T + 1.69 \times (V - 0.13 \text{ mm (0.0051 in)})$

Exhaust side: $S = T + 1.87 \times (V - 0.22 \text{ mm (0.0087 in)})$

S: Valve shim thickness required

V: Measured cam clearance

T: Current valve shim thickness

- (4) Install the cam carrier LH. [Ref. to MECHANICAL\(H4DO\)>Cam Carrier>INSTALLATION > CAM CARRIER LH.](#)

- (5) Check all the cam clearance of LH side at this time. If the cam clearance is not within the standard value, repeat the procedure over again from step (1).

Note:

When the removing/installing of cam carrier LH has been performed, cam clearance may be outside the standard value. Checking of all cam clearance of LH side is necessary. Refer to INSPECTION of "Cam Clearance" for the cam clearance inspection. [Ref. to MECHANICAL\(H4DO\)>Cam Clearance>INSPECTION > WHEN TIMING CHAIN ASSEMBLY IS REMOVED.](#)

Cam clearance:

Intake

Standard

$0.13^{+0.02}_{-0.03}$ mm ($0.0051^{+0.0008}_{-0.0012}$ in)

Exhaust**Standard**

0.22 ± 0.02 mm (0.0087 ± 0.0008 in)

5. After adjustment, install the related parts in the reverse order of removal.

MECHANICAL(H4DO) > Engine Assembly

REMOVAL



SUBARU
SST

1. Fully open the panel COMPL front hood. Ref. to REPAIR CONTENTS>NOTE > STAY ASSEMBLY FRONT HOOD.
2. Release the fuel pressure. Ref. to FUEL INJECTION (FUEL SYSTEMS)(H4DO)>Fuel>PROCEDURE > RELEASING OF FUEL PRESSURE.
3. Open the fuel filler lid and remove the fuel filler cap.

Note:

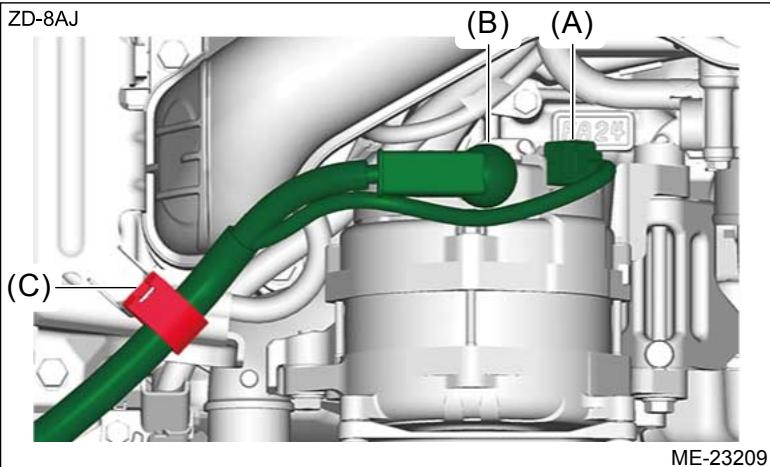
This operation is required to release the inner pressure of the fuel tank.

4. Disconnect the ground terminal of battery sensor. Ref. to REPAIR CONTENTS>NOTE > BATTERY.
5. Collect the refrigerant. Ref. to AIR CONDITIONER>Refrigerant Recovery Procedure>PROCEDURE.
6. Drain engine coolant. Ref. to COOLING(H4DO)>Engine Coolant>REPLACEMENT > DRAINING OF ENGINE COOLANT.
7. Remove the air cleaner case. Ref. to INTAKE (INDUCTION)(H4DO)>Air Cleaner Case>REMOVAL.

Note:

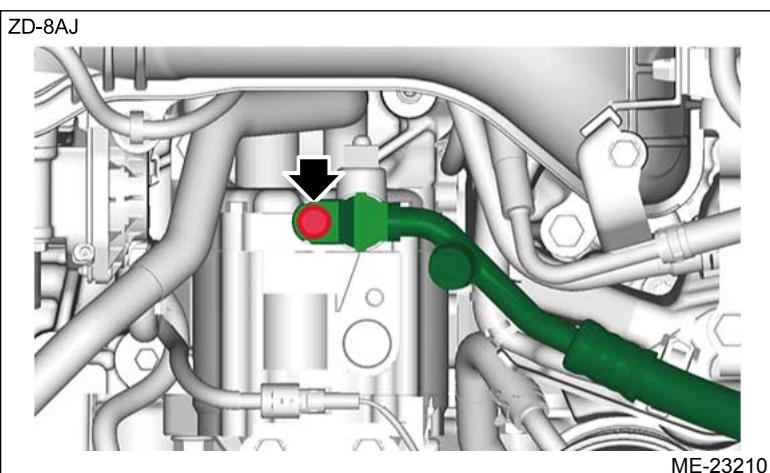
When removing/installing the engine unit, the chain cover may come in contact with the air cleaner case bracket. Therefore, the air cleaner case bracket must also be removed.

8. Remove the air intake boot. Ref. to INTAKE (INDUCTION)(H4DO)>Air Intake Boot>REMOVAL.
9. Remove the radiator inlet hose. Ref. to COOLING(H4DO)>Radiator Hose>REMOVAL > RADIATOR INLET HOSE.
10. Remove the ECM. Ref. to FUEL INJECTION (FUEL SYSTEMS)(H4DO)>Engine Control Module (ECM)>REMOVAL.
11. Remove the collector cover. Ref. to FUEL INJECTION (FUEL SYSTEMS)(H4DO)>Collector Cover>REMOVAL.
12. Remove the strut tower bar. Ref. to FRONT SUSPENSION>Strut Tower Bar>REMOVAL.
13. Remove the brake vacuum hose & pipe. Ref. to BRAKE>Brake Vacuum Pump>REMOVAL > BRAKE VACUUM HOSE & PIPE.
14. Disconnect the connector (A) and terminal (B) from the generator.
15. Remove the clip (C) securing the generator cord to the fuel pipe protector RH No. 1, and place it aside so that it does not interfere with the work.

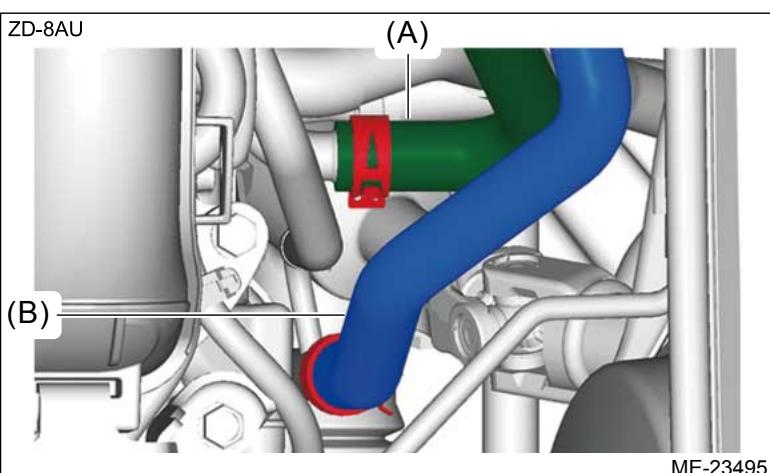


16. Remove the hose pressure suction. [Ref. to AIR CONDITIONER>Hose and Pipe>REMOVAL.](#)

17. Disconnect the hose pressure discharge from the A/C compressor. [Ref. to AIR CONDITIONER>Hose and Pipe>REMOVAL.](#)

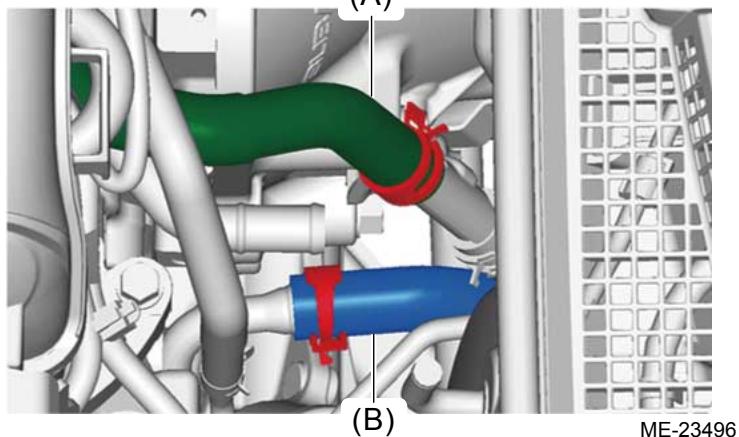


18. Disconnect the heater inlet hose (A) and the heater outlet hose (B) from the water tank pipe assembly and the water pipe.



19. Disconnect the water hose (A) and the water hose (B) from the oil cooler pipe and the water pipe. (AT model)

ZD-8AU

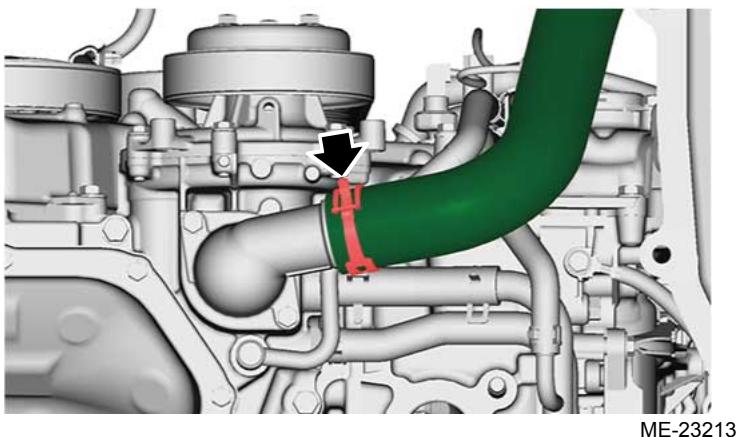


20. Remove the front exhaust pipe. [Ref. to EXHAUST\(H4DO\)>Front Exhaust Pipe>REMOVAL.](#)

21. Remove the sub frame front LWR C COMPL LH. [Ref. to FRONT SUSPENSION>Sub Frame>REMOVAL.](#)

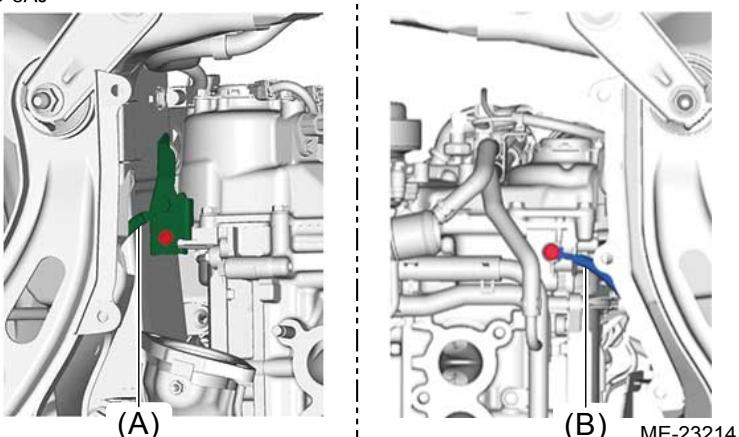
22. Disconnect the radiator outlet hose from the engine unit.

ZD-8AJ



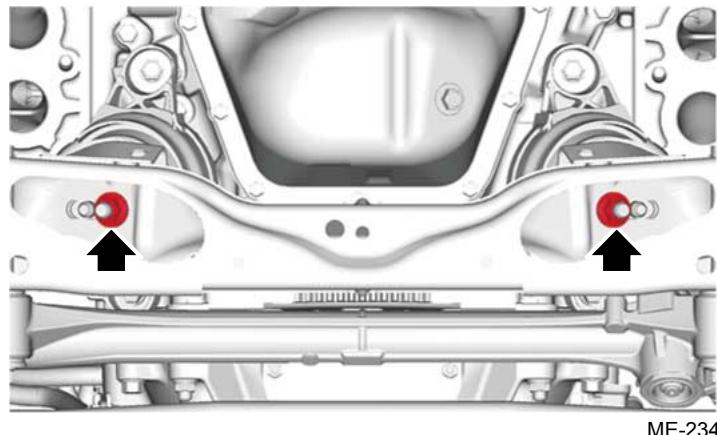
23. Remove the ground cord RH (A) together with the rear oxygen sensor bracket from the engine unit and disconnect the ground cord LH (B) on the engine unit side.

ZD-8AJ



24. Remove the nuts which secure the engine mounting to the crossmember COMPL front.

ZD-8AU



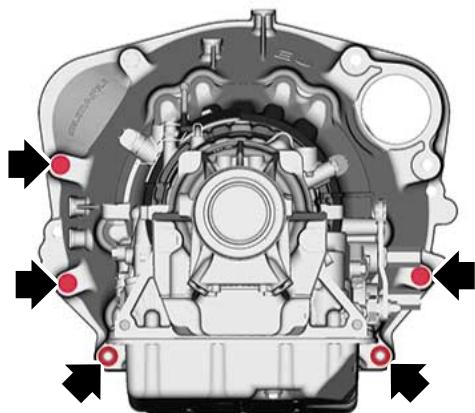
- 25.** Remove the bolts (3 locations) and nuts (2 locations) which hold the transmission body to the engine unit as shown in the figure.

Note:

For the MT model, remove the cover plate (a) together with the bolts.

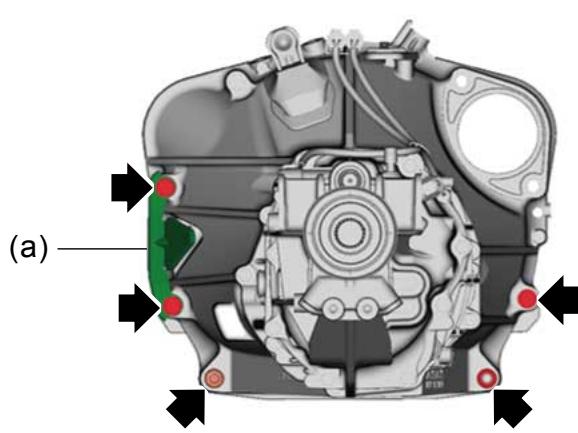
- AT model

ZD-8AJ



- MT model

ZD-8AJ



- 26.** Attach the ST to the transmission body. (AT model)

Preparation tool:

ST: STAND ASSY (18632AA010)

(1) Remove the stabilizer front and the sub frame COMPL.  Ref. to FRONT

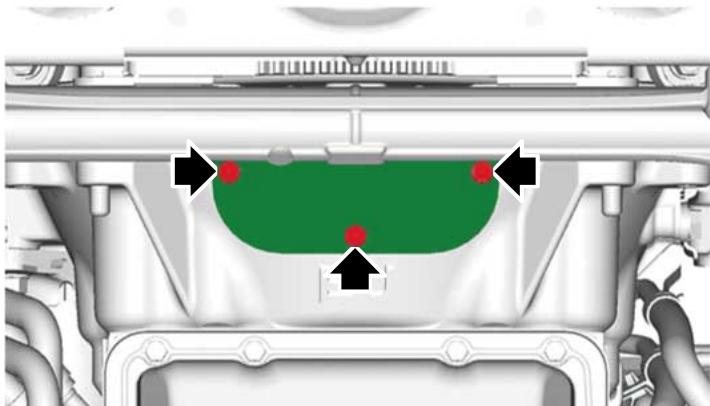
SUSPENSION>Stabilizer>REMOVAL.

(2) Remove the cover from the converter case.

Caution:

Be sure to perform this procedure to prevent the cover from being damaged by the ST.

ZD-8AU



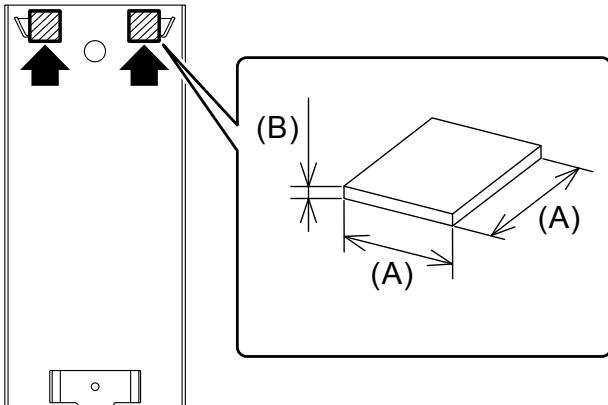
ME-23500

(3) Attach the rubber sheet to the ST with double sided tape, etc. at the location shown in the figure.

Caution:

Be sure to perform this procedure to prevent the transmission body from being damaged by the ST.

ZD-8AJ



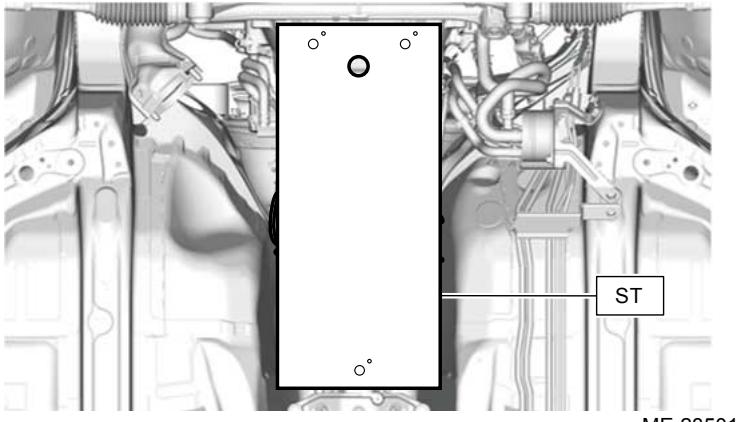
ME-23219

(A) Approx. 45 mm (Approx.
1.77 in)

(B) Approx. 5 mm (Approx.
0.20 in)

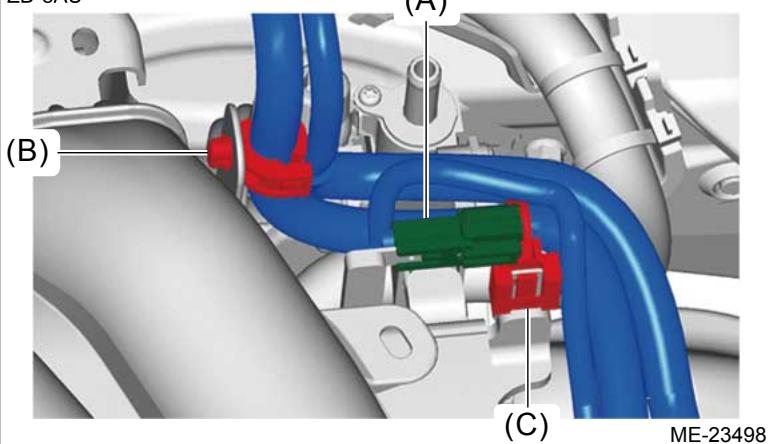
(4) Attach the ST to the transmission body with a rope, etc.

ZD-8AU



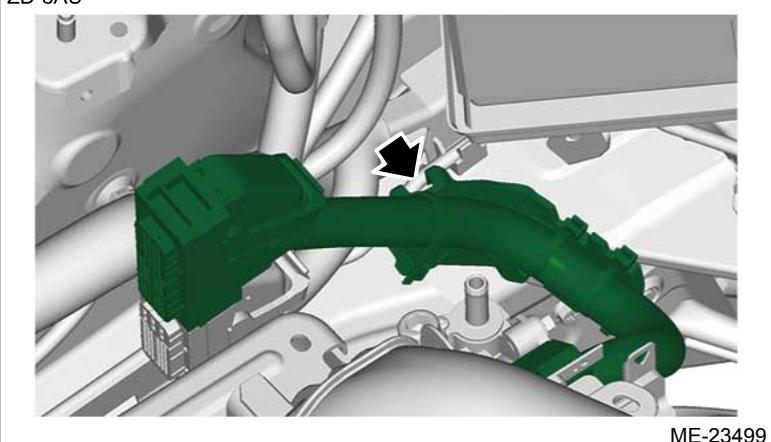
27. Remove the starter. [Ref. to STARTING/CHARGING SYSTEMS\(H4DO\)>Starter>REMOVAL.](#)
28. Remove the connector (A) from the engine rear hanger and remove the clip (B) securing the battery cable assembly to the intake manifold assembly.
29. Remove the clip (C) securing the battery cable assembly to the engine rear hanger, and place it aside so that it does not interfere with work.

ZD-8AU



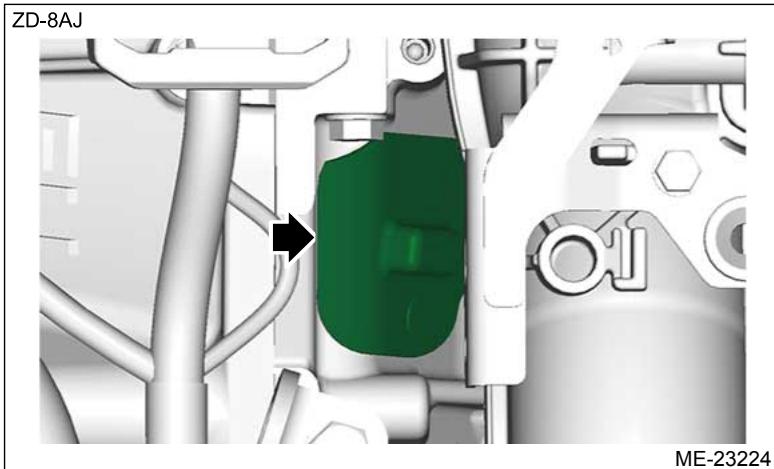
30. Remove the clip securing the engine wiring harness to the vehicle.

ZD-8AU

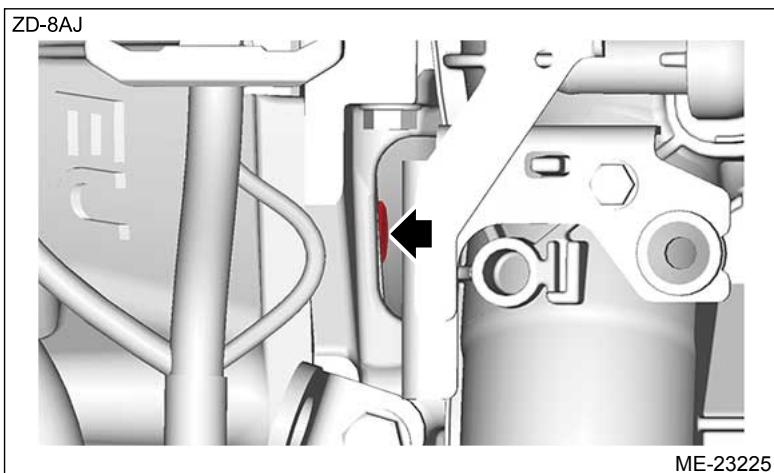


31. Separate the torque converter from drive plate. (AT model)
 - (1) Remove the PCV hose No. 1. [Ref. to EMISSION CONTROL \(AUX. EMISSION CONTROL DEVICES\) \(H4DO\)>PCV Hose>REMOVAL > PCV HOSE NO. 1.](#)

(2) Remove the plug from the service hole.



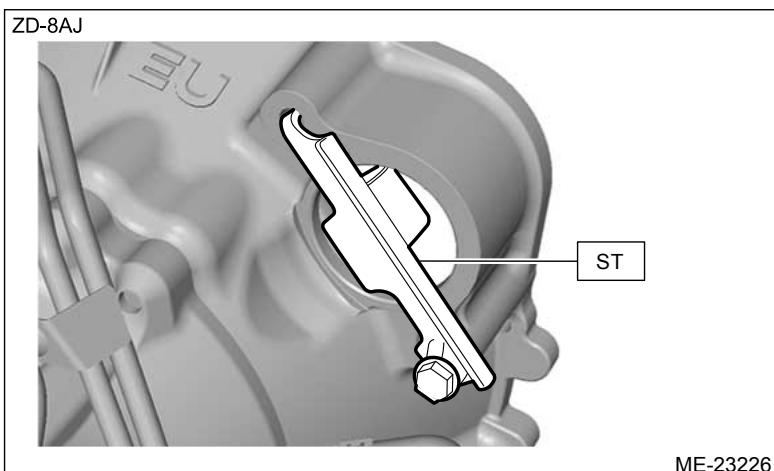
(3) Insert the wrench into the crank pulley bolt, and rotate the crank pulley to remove the bolts (6 places) securing the torque converter to the drive plate.



(4) Attach the ST to the converter case.

Preparation tool:

ST: STOPPER SET (18750AA010)



32. Disconnect the fuel delivery tube and evaporation hose.

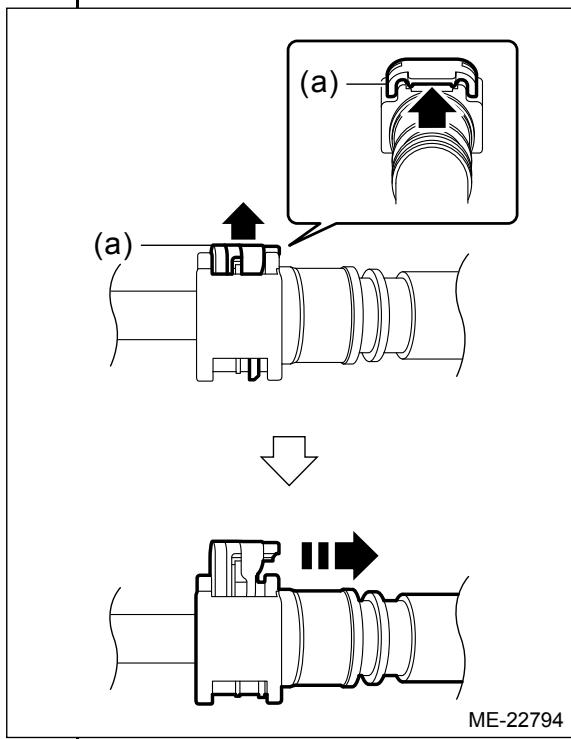
Caution:

- Be careful not to spill fuel.
- Catch the fuel from the tubes using a container or cloth.

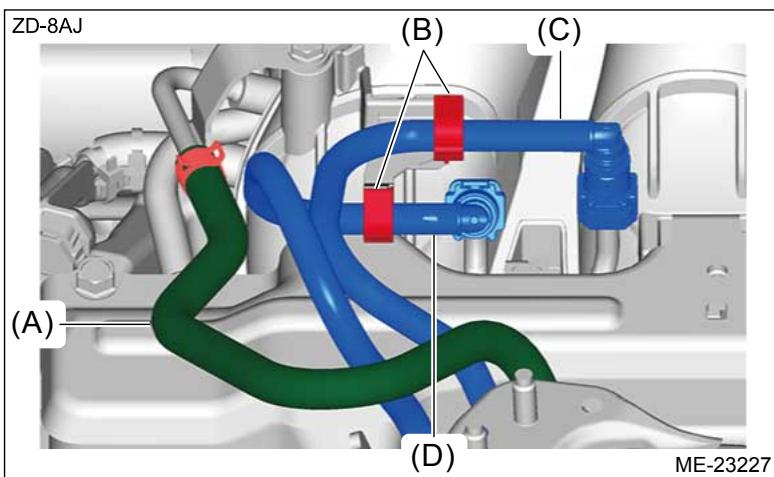
- (1) Disconnect the evaporation hose (A) from the vacuum pipe.
- (2) Open the claw (B) on the fuel delivery tube clamp.
- (3) Disconnect the quick connector on the fuel delivery tube (cylinder direct injection side) (C) from the fuel delivery pipe assembly, and disconnect the quick connector on the fuel delivery tube (port injection side) (D) from the fuel pipe LH.

Note:

Disconnect the quick connector as shown in the figure.



(a) Slider



33. Separate the engine unit and transmission.

Caution:

Before removing the engine unit away from transmission, check to be sure no work has been overlooked.

- (1) Using the ST1, install the ST2 to the engine unit.

Preparation tool:

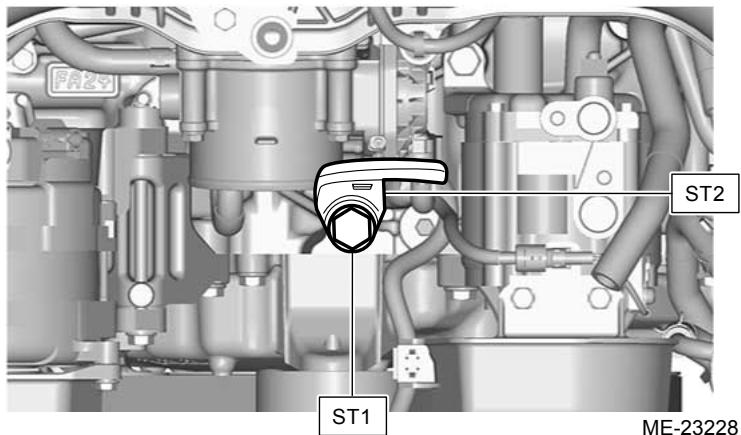
ST1: BOLT (90119-14120)

ST2: ENGINE HANGER NO.1 (12281-38150)

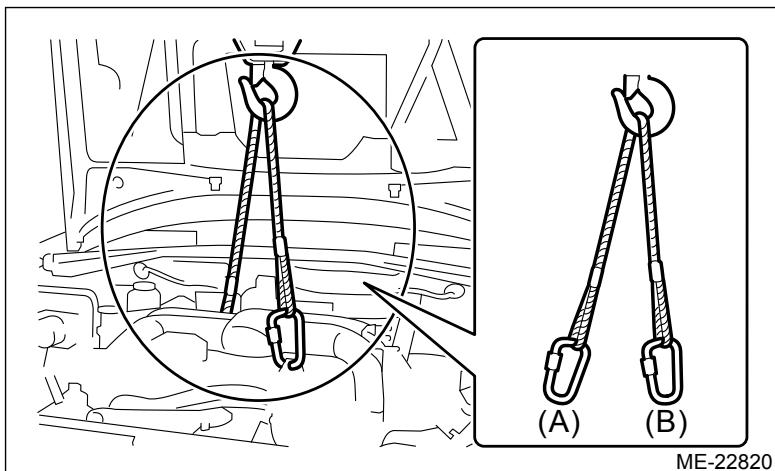
Tightening torque:

43 N·m (4.4 kgf-m, 31.7 ft-lb)

ZD-8AJ



- (2) Support the engine unit with a lifting device and wire ropes.



(A) To engine rear hanger

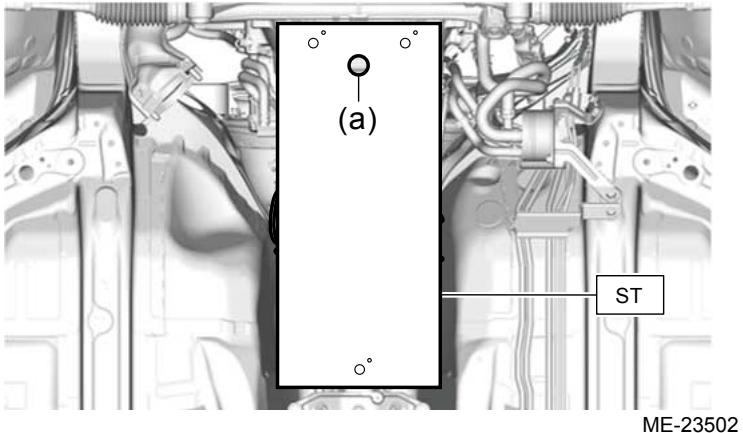
(B) To ST (ENGINE HANGER
NO.1)

- (3) Support the transmission with a garage jack.

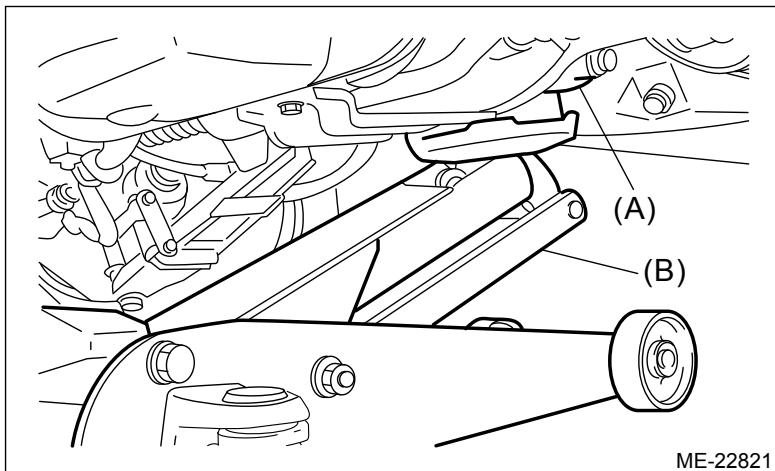
Caution:

- Be sure to perform this procedure to prevent the transmission from lowering by its own weight.
- For the AT model, support the (a) part of ST with a garage jack.

ZD-8AU



- For the MT model, be careful not to let the garage jack come in contact with the front stabilizer.



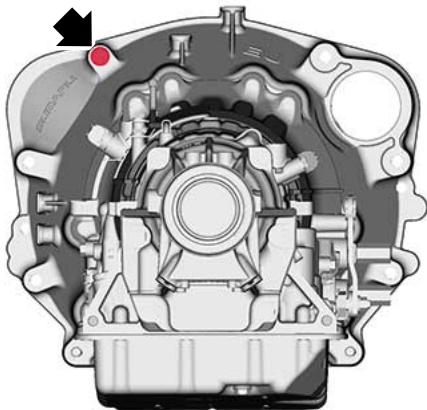
(A) Transmission

(B) Garage jack

- (4) Remove the bolt (1 location) which holds the transmission body to the engine unit as shown in the figure.

- AT model

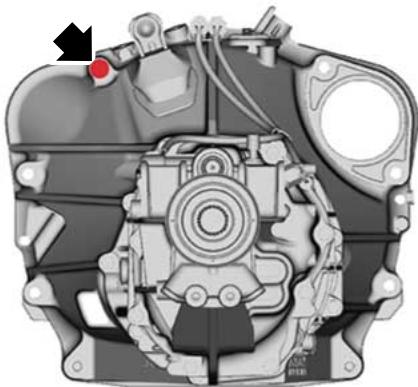
ZD-8AJ



ME-23230

- MT model

ZD-8AJ



ME-23231

34. Remove the engine unit from the vehicle.

Note:

Be careful not to damage adjacent parts or body panels with crank pulley, oil level gauge, etc.

- (1) With a lifting device and a garage jack, lift the engine unit together with the transmission body.

Caution:

When lifting up the engine unit, pay attention to the clearance of each part and be careful not to lift the engine too much, in order to prevent damaging the vehicle.

Note:

Lift it high enough until the stud bolt of the engine mounting is completely drawn out of the crossmember COMPL front.

- (2) Move the engine unit horizontally until the engine unit is withdrawn from transmission body. (AT model)

Note:

If it is hard to pull out the stud bolt from the transmission body, precisely adjust the height of the transmission body with garage jack so that no load is applied to the stud bolt.

- (3) Move the engine unit horizontally until the clutch disc is pulled out from the main shaft and the engine unit is withdrawn from transmission body. (MT model)

Note:

If it is hard to pull out the stud bolt from the transmission body, precisely adjust the height of the transmission body with garage jack so that no load is applied to the stud bolt.

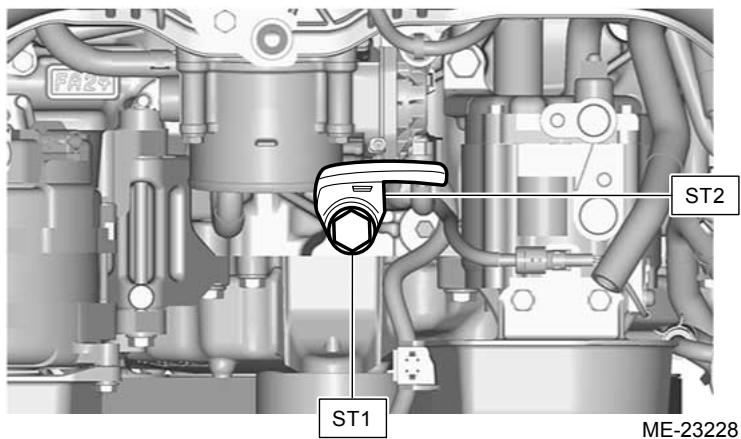
(4) Slowly move the engine unit away from engine compartment.

35. Remove the engine mounting from the engine unit.

36. Set the engine unit on the engine stand, etc. and remove the lifting device and wire ropes.  [Ref. to MECHANICAL\(H4DO\)>Preparation for Overhaul>PROCEDURE.](#)

37. Remove the ST1 and ST2 from the engine unit.

ZD-8AJ



MECHANICAL(H4DO) > Engine Assembly

INSTALLATION

1. Using the ST1, install the ST2 to the engine unit.

Preparation tool:

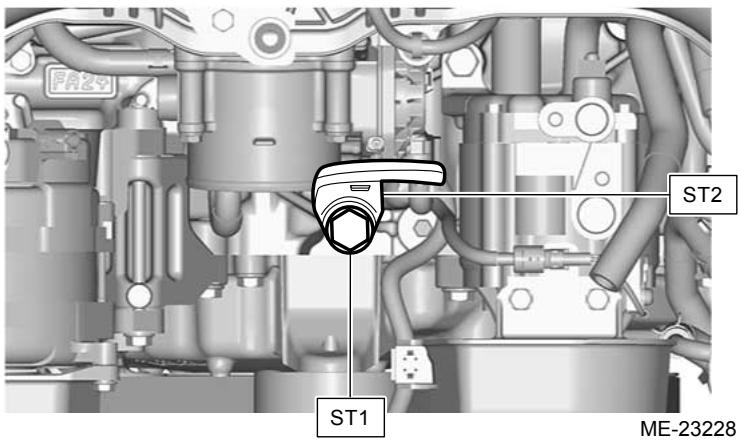
ST1: BOLT (90119-14120)

ST2: ENGINE HANGER NO.1 (12281-38150)

Tightening torque:

43 N·m (4.4 kgf-m, 31.7 ft-lb)

ZD-8AJ



2. Support the engine unit with a lifting device and wire ropes, and remove the engine unit from the engine stand, etc.

- 3.** Install the engine mounting onto the engine unit.

Tightening torque:

35 N·m (3.6 kgf-m, 25.8 ft-lb)

- 4.** Apply a small amount of grease to splines of main shaft. (MT model)

Preparation items:

Grease: NICHIMOLY N-130 or equivalent

- 5.** Place the engine unit in engine compartment and align it with transmission body. (AT model)

Note:

- Be careful not to damage adjacent parts or body panels with crank pulley, oil level gauge, etc.
- If it is hard to insert the knock pin on the engine unit into the transmission body, precisely adjust the height of the transmission body with garage jack so that no load is applied to the knock pin.

- 6.** Position the engine unit in engine compartment, insert the clutch disc into the main shaft, and align it with the transmission body. (MT model)

Note:

- Be careful not to damage adjacent parts or body panels with crank pulley, oil level gauge, etc.
- If it is hard to insert the clutch disc into the main shaft, insert the wrench into the crank pulley bolt, and rotate the crank pulley slightly to insert it.
- If it is hard to insert the knock pin on the engine unit into the transmission body, precisely adjust the height of the transmission body with garage jack so that no load is applied to the knock pin.

- 7.** With a lifting device and a garage jack, slowly lower the engine unit together with the transmission body.

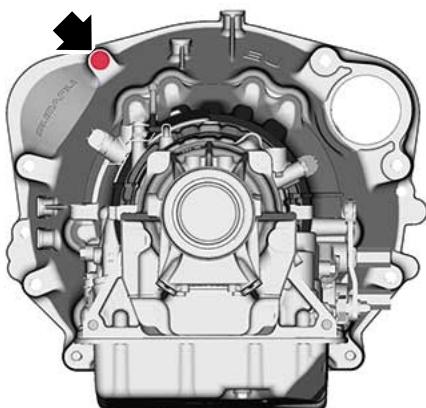
Note:

Check that the stud bolt of the engine mounting is securely inserted into the engine mounting hole of the crossmember COMPL front.

- 8.** Temporarily tighten the bolt (1 location) which holds the transmission body to the engine unit as shown in the figure.

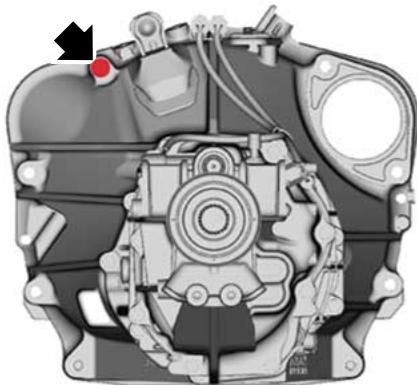
- AT model

ZD-8AJ



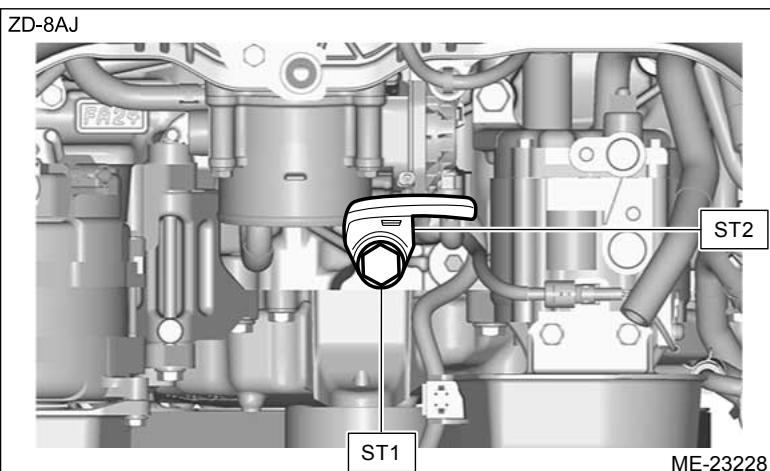
ME-23230

- MT model



ME-23231

- 9.** Remove the garage jack.
- 10.** Remove the lifting device and wire ropes.
- 11.** Remove the ST1 and ST2 from the engine unit.



ME-23228

- 12.** Connect the fuel delivery tube and evaporation hose.

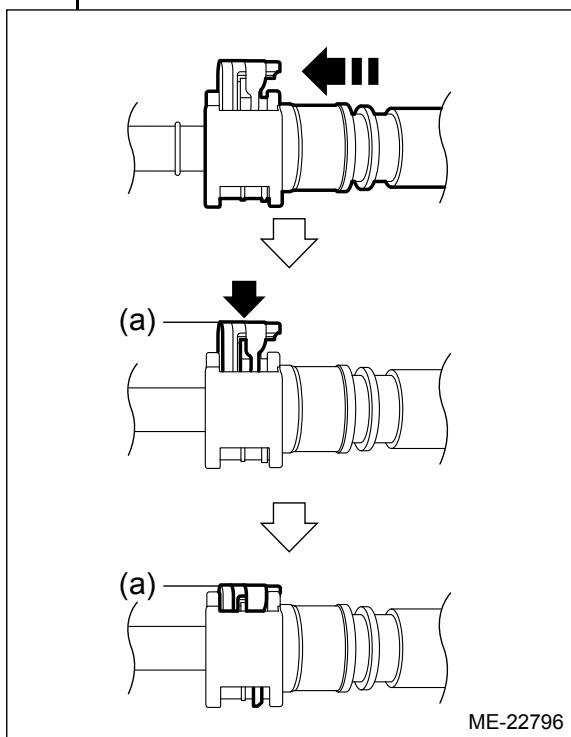
- (1) Connect the quick connector on the fuel delivery tube (port injection side) (A) to the fuel pipe LH, and connect the quick connector on the fuel delivery tube (cylinder direct injection side) (B) to the fuel delivery pipe assembly.

Caution:

- Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the pipe.
- When connecting the quick connector, make sure to insert it all the way in before locking the slider.
- When it is difficult to lock the slider, check that the connector is fully inserted.
- After locking the slider, pull the quick connector itself to the disconnecting direction, and then push to the connecting direction in order to confirm secure connection. Always make sure to perform this confirmation ending up with a pushing in.

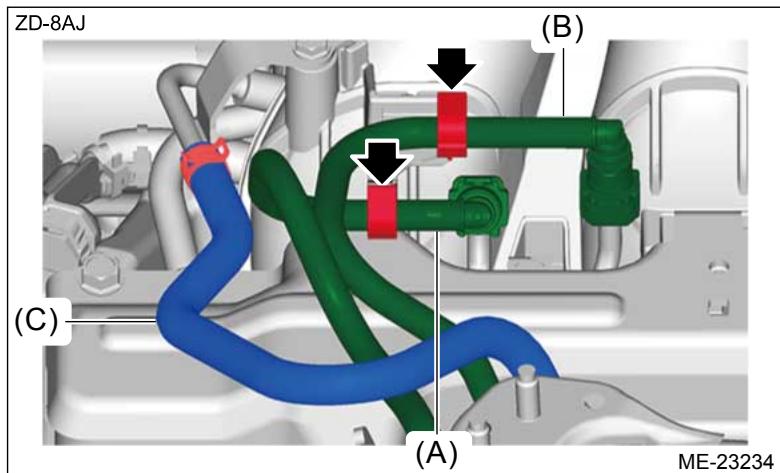
Note:

Connect the quick connector as shown in the figure.



(a) Slider

- (2) Install the fuel delivery tube (port injection side) (A) and fuel delivery tube (cylinder direct injection side) (B) to the fuel delivery tube clamp.
- (3) Connect the evaporation hose (C) to the vacuum pipe.

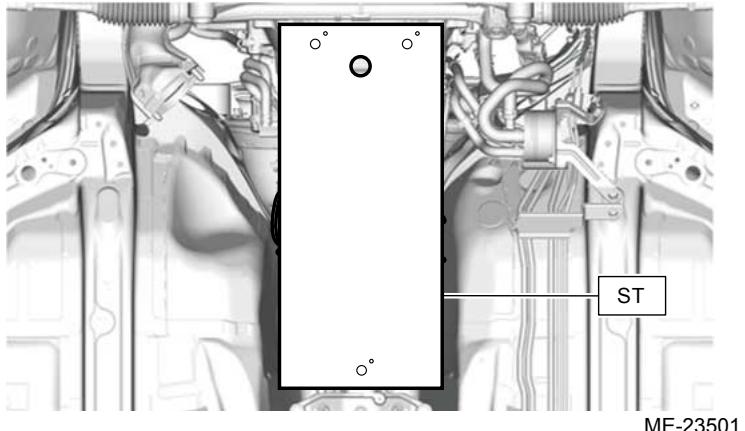


13. Lift up the vehicle.

14. Remove the ST from the transmission body. (AT model)

- (1) Remove the ST from the transmission body.

ZD-8AU

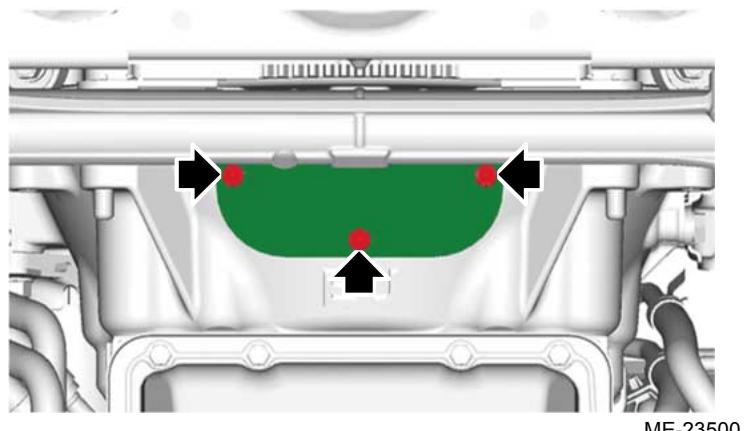


(2) Install cover to the converter case.

Tightening torque:

7.4 N·m (0.8 kgf-m, 5.5 ft-lb)

ZD-8AU



(3) Install the stabilizer front and the sub frame COMPL. [Ref. to FRONT SUSPENSION>Stabilizer>INSTALLATION.](#)

15. Install the bolts (3 locations) and nuts (2 locations) which hold the transmission body to the engine unit as shown in the figure.

Note:

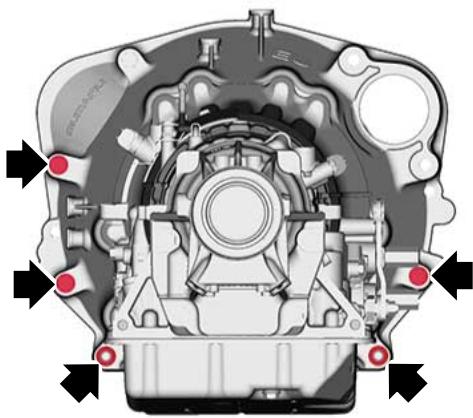
For the MT model, install the cover plate (a) together with the bolts.

Tightening torque:

50 N·m (5.1 kgf-m, 36.9 ft-lb)

- AT model

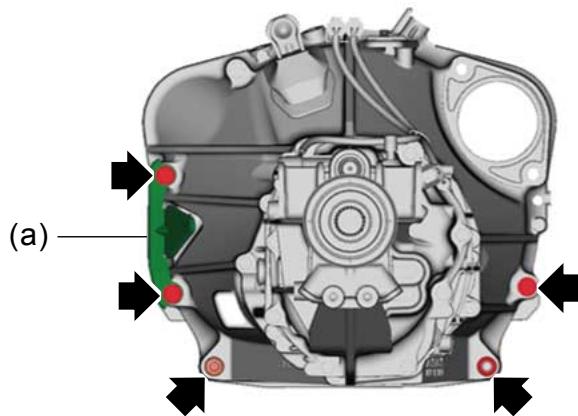
ZD-8AJ



ME-23216

- MT model

ZD-8AJ



ME-23217

16. Install the nuts which hold the engine mounting to the crossmember COMPL front.

Caution:

Be sure to use a new nut.

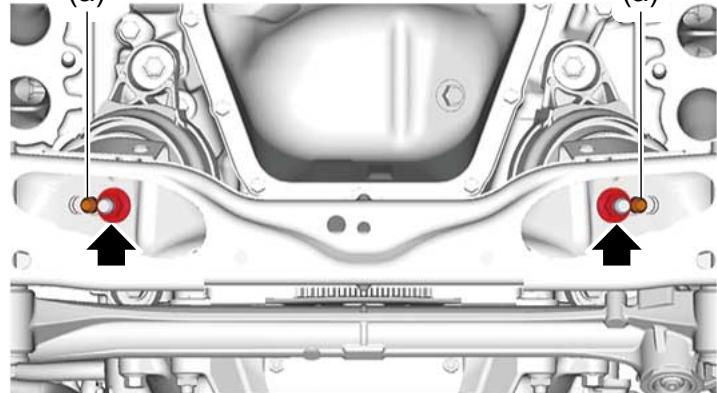
Note:

Make sure that locators (a) of the engine mounting are securely inserted.

Tightening torque:

90 N·m (9.2 kgf-m, 66.4 ft-lb)

ZD-8AU (a)



ME-23503

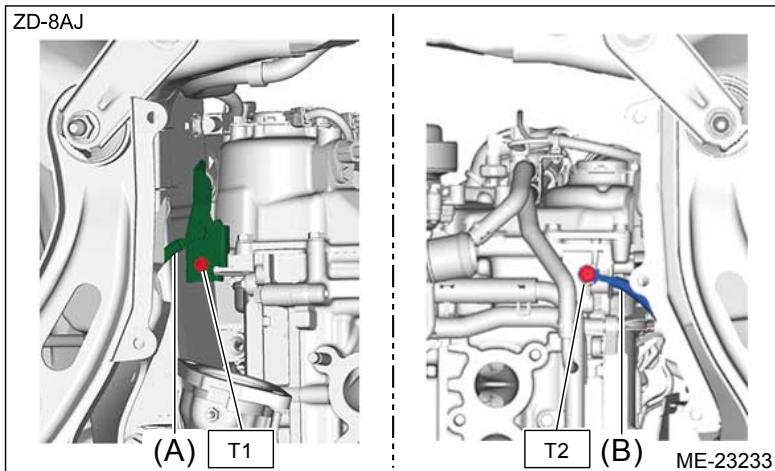
17. Install the ground cord RH (A) together with the rear oxygen sensor bracket to the engine unit and

connect the ground cord LH (B).

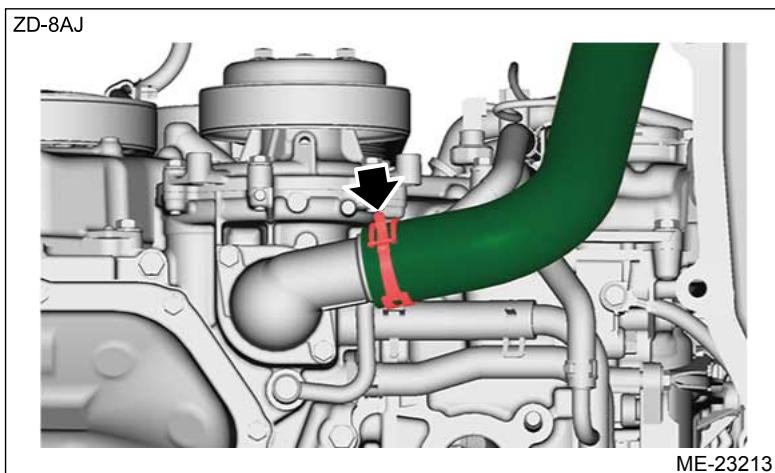
Tightening torque:

T1: 9.5 N·m (1.0 kgf-m, 7.0 ft-lb)

T2: 7.5 N·m (0.8 kgf-m, 5.5 ft-lb)



18. Connect the radiator outlet hose to the engine unit.



19. Install the sub frame front LWR C COMPL LH. Ref. to FRONT SUSPENSION>Sub Frame>INSTALLATION.

20. Install the front exhaust pipe. Ref. to EXHAUST(H4DO)>Front Exhaust Pipe>INSTALLATION.

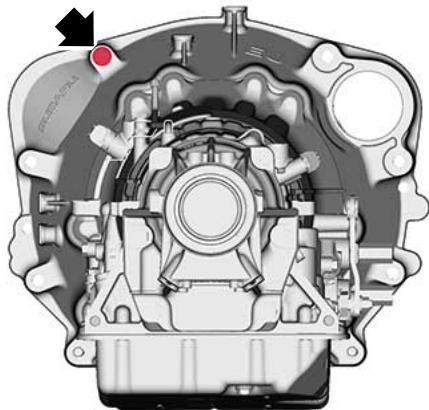
21. Tighten the bolt which holds the transmission body to the engine unit as shown in the figure.

Tightening torque:

50 N·m (5.1 kgf-m, 36.9 ft-lb)

- AT model

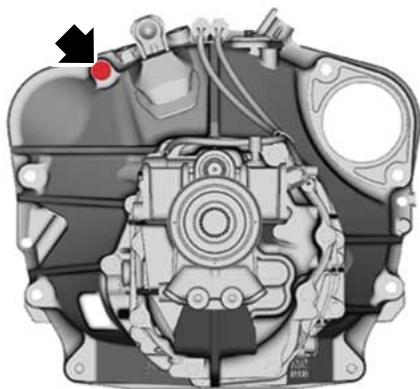
ZD-8AJ



ME-23230

- MT model

ZD-8AJ

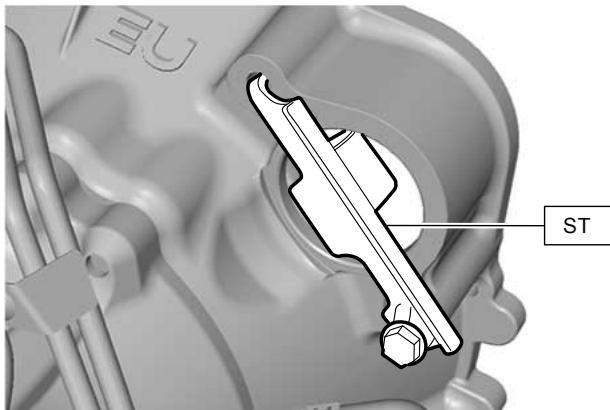


ME-23231

22. Install the torque converter to drive plate. (AT model)

- (1) Remove the ST from converter case.

ZD-8AJ



ME-23226

- (2) Insert the wrench into the crank pulley bolt, and rotate the crank pulley to attach the bolts (6 places) securing the torque converter to the drive plate.

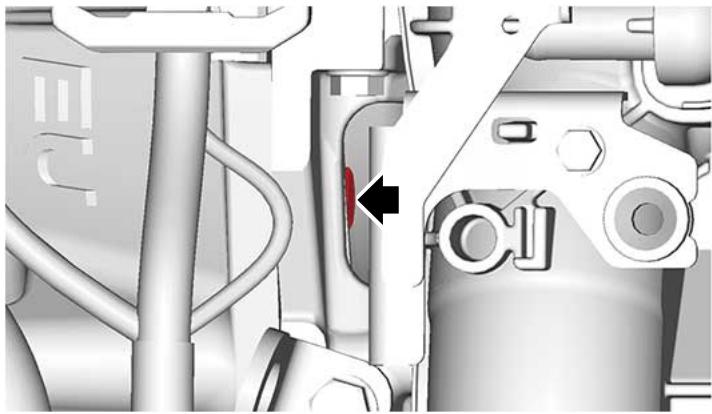
Note:

Be careful not to drop bolts into the converter housing.

Tightening torque:

25 N·m (2.5 kgf-m, 18.4 ft-lb)

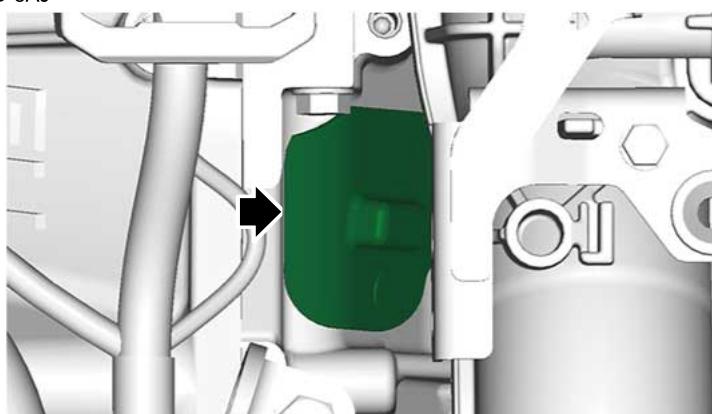
ZD-8AJ



ME-23225

(3) Fit the plug to service hole.

ZD-8AJ

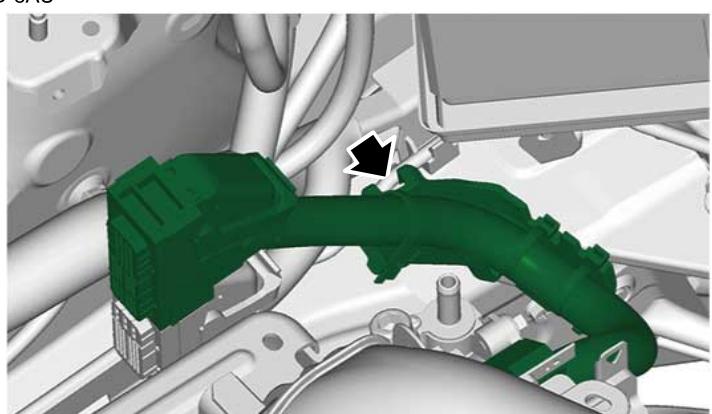


ME-23224

(4) Install the PCV hose No. 1. [Ref. to EMISSION CONTROL \(AUX. EMISSION CONTROL DEVICES\) \(H4DO\) > PCV Hose > INSTALLATION > PCV HOSE NO. 1.](#)

23. Secure the engine wiring harness to the vehicle with the clip.

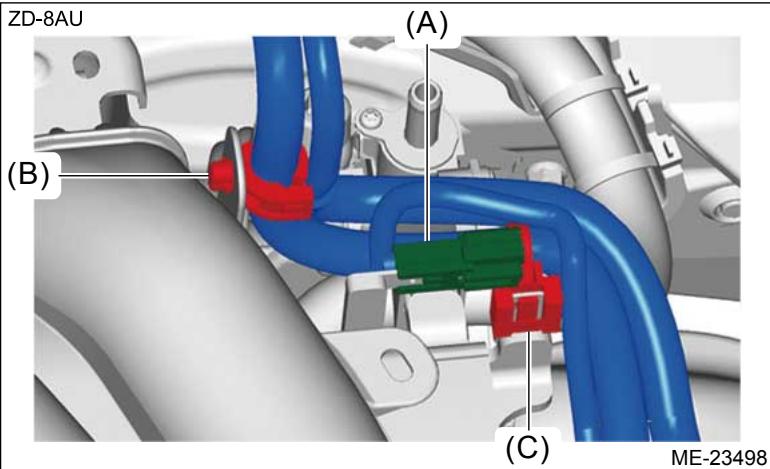
ZD-8AU



ME-23499

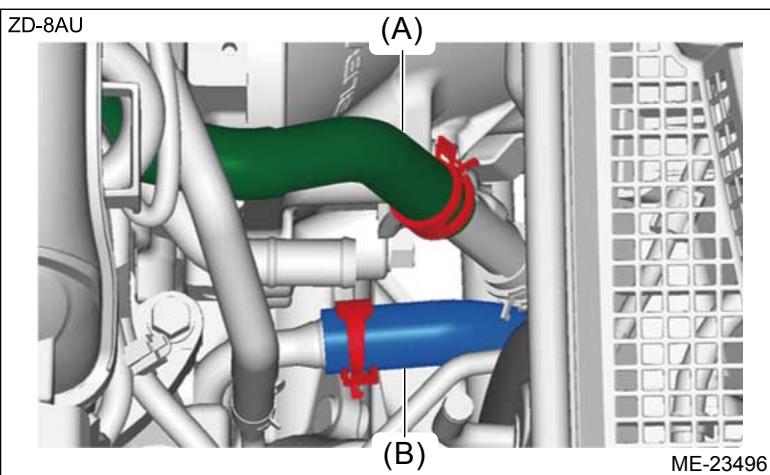
24. Set the battery cable assembly, and secure the battery cable assembly to the engine rear hanger with clip (C).

25. Secure the battery cable assembly to the intake manifold assembly with clip (B), and connect the connector (A) to the engine rear hanger.

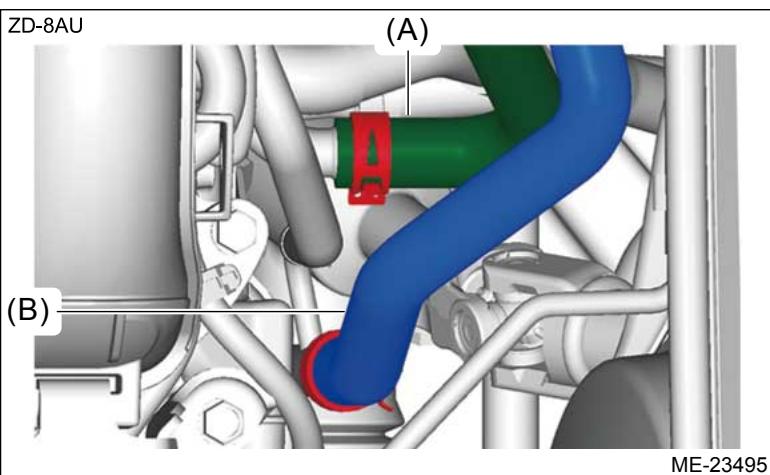


26.Install the starter. [Ref. to STARTING/CHARGING SYSTEMS\(H4DO\)>Starter>INSTALLATION.](#)

27.Connect the water hose (A) and the water hose (B) to the oil cooler pipe and the water pipe. (AT model)



28.Connect the heater inlet hose (A) and the heater outlet hose (B) to the water tank pipe assembly and the water pipe.



29.Connect the hose pressure discharge to the A/C compressor. [Ref. to AIR CONDITIONER>Hose and Pipe>INSTALLATION.](#)

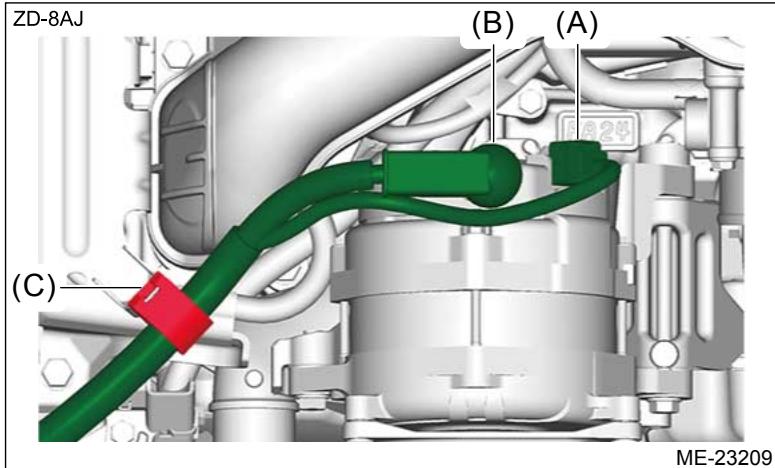
30.Install the hose pressure suction. [Ref. to AIR CONDITIONER>Hose and Pipe>INSTALLATION.](#)

31.Set the generator cord, and secure the generator cord to the fuel pipe protector RH No. 1 using clip (C).

32.Connect the connector (A) and terminal (B) to the generator.

Tightening torque:

15.5 N·m (1.6 kgf-m, 11.4 ft-lb)



33. Install the brake vacuum hose & pipe. [Ref. to BRAKE>Brake Vacuum Pump>INSTALLATION > BRAKE VACUUM HOSE & PIPE.](#)
34. Install the strut tower bar. [Ref. to FRONT SUSPENSION>Strut Tower Bar>INSTALLATION.](#)
35. Install the collector cover. [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>Collector Cover>INSTALLATION.](#)
36. Install the ECM. [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>Engine Control Module \(ECM\)>INSTALLATION.](#)
37. Attach the radiator inlet hose. [Ref. to COOLING\(H4DO\)>Radiator Hose>INSTALLATION > RADIATOR INLET HOSE.](#)
38. Install the air intake boot. [Ref. to INTAKE \(INDUCTION\)\(H4DO\)>Air Intake Boot>INSTALLATION.](#)
39. Install the air cleaner case. [Ref. to INTAKE \(INDUCTION\)\(H4DO\)>Air Cleaner Case>INSTALLATION.](#)
40. Connect the ground terminal to the battery sensor. [Ref. to REPAIR CONTENTS>NOTE > BATTERY.](#)
41. Install the fuel filler cap, and close the fuel filler lid.
42. Fill engine coolant. [Ref. to COOLING\(H4DO\)>Engine Coolant>REPLACEMENT > FILLING OF ENGINE COOLANT.](#)
43. Set the panel COMPL front hood to the normal position. [Ref. to REPAIR CONTENTS>NOTE > STAY ASSEMBLY FRONT HOOD.](#)
44. Check the select lever and adjust it if necessary. (AT model)

Inspection:

[Ref. to CONTROL SYSTEMS>Select Lever>INSPECTION.](#)

Adjustment:

[Ref. to CONTROL SYSTEMS>Select Lever>ADJUSTMENT.](#)

Note:

This procedure is required because the select lever may be deviated from the adjusted position due to installation/removal of the nut on the engine mounting.

MECHANICAL(H4DO) > Engine Assembly

INSPECTION

1. Check that pipes, hoses, connectors and clamps are installed firmly.
2. Check the engine coolant is at specified level.

3. Start the engine and check for exhaust gas, engine coolant, leaks of fuel, etc. Also check for noise and vibrations.

MECHANICAL(H4DO) > Engine Mounting

REMOVAL



1. Fully open the panel COMPL front hood. [Ref. to REPAIR CONTENTS>NOTE > STAY ASSEMBLY FRONT HOOD.](#)
2. Disconnect the ground terminal of battery sensor. [Ref. to REPAIR CONTENTS>NOTE > BATTERY.](#)
3. Perform the steps below to remove the air intake boot, and place it aside so that it does not interfere with the work.

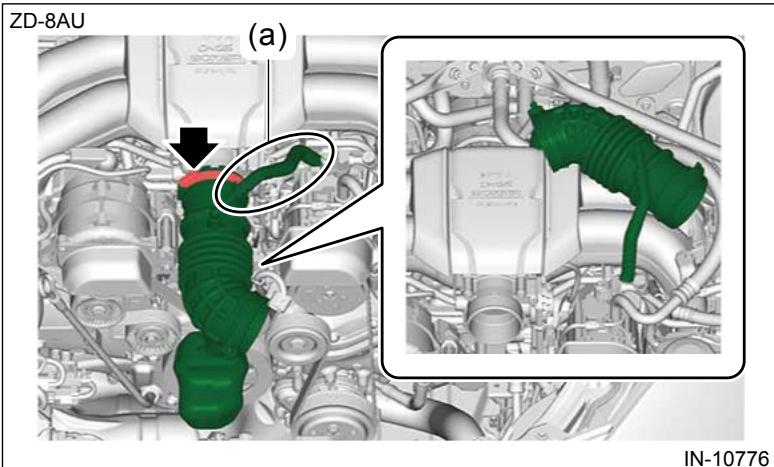
Caution:

Do not remove the PCV hose No. 2 (a).

- (1) Remove the air cleaner case. [Ref. to INTAKE \(INDUCTION\)\(H4DO\)>Air Cleaner Case>REMOVAL.](#)
- (2) Loosen the clamp, remove the air intake boot, and place it aside so that it does not interfere with the work.

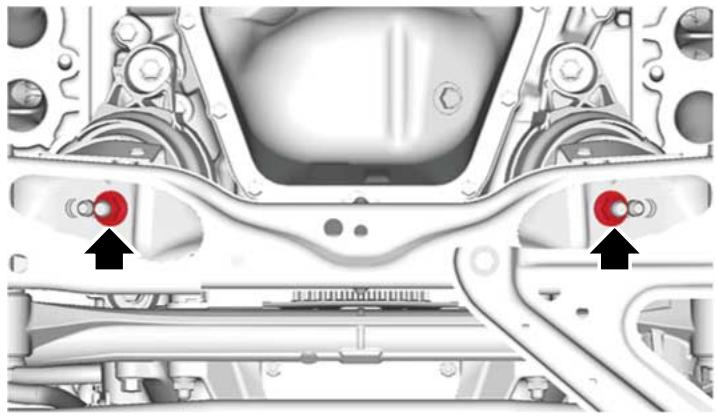
Caution:

Be careful not to pull out the PCV hose No. 2 (a).



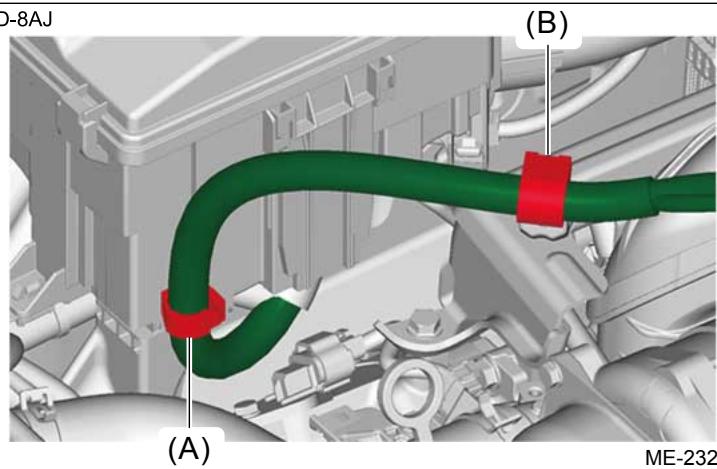
4. Remove the ECM. [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>Engine Control Module \(ECM\)>REMOVAL.](#)
5. Remove the front exhaust pipe. [Ref. to EXHAUST\(H4DO\)>Front Exhaust Pipe>REMOVAL.](#)
6. Remove the nuts which secure the engine mounting to the crossmember COMPL front.

ZD-8AU



7. Lower the vehicle.
8. Open the claw of the clip (A) which secures the generator cord to the main fuse box and remove the generator cord.
9. Remove the clip (B) securing the generator cord to the fuel pipe protector RH No. 1.

ZD-8AJ



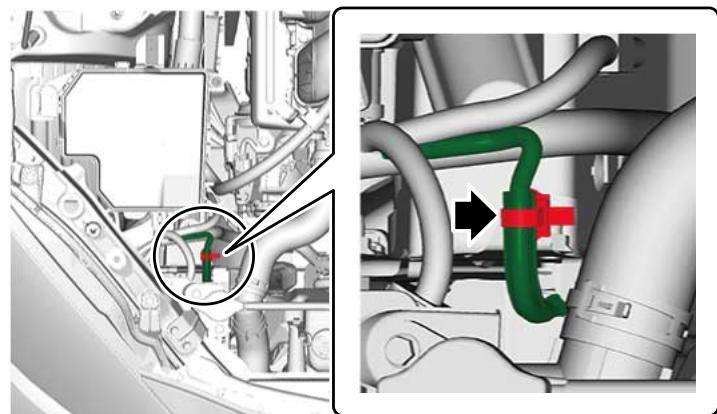
10. Remove the clip securing the bulkhead wiring harness to the vehicle.

Note:

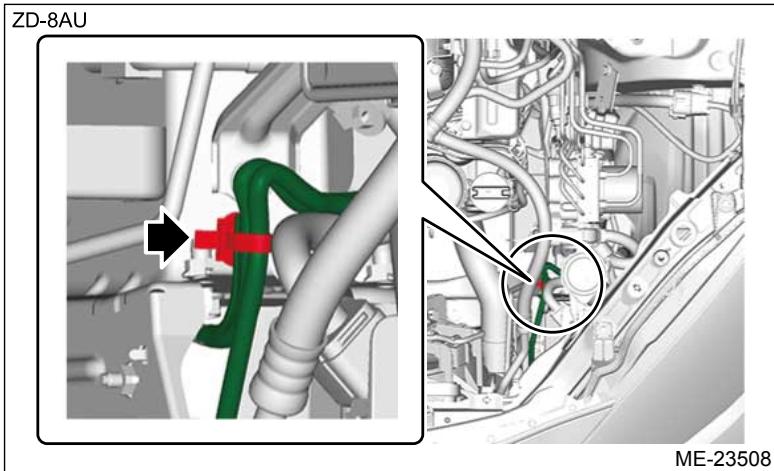
This procedure is required to prevent the bulkhead wiring harness from being damaged by the adjuster (ST).

- RH side

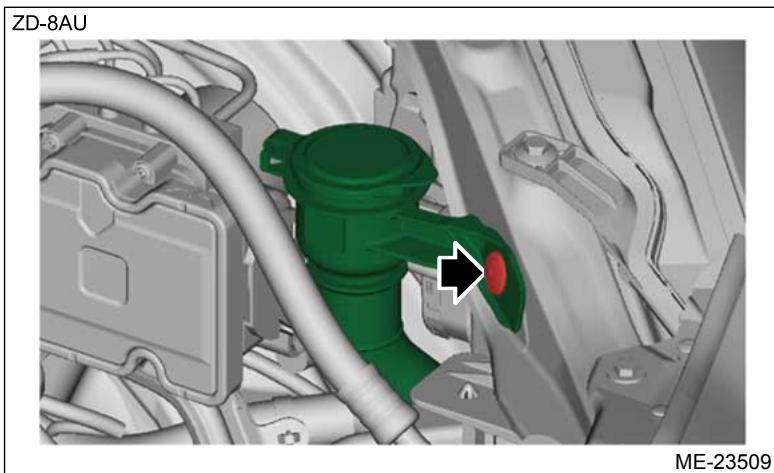
ZD-8AU



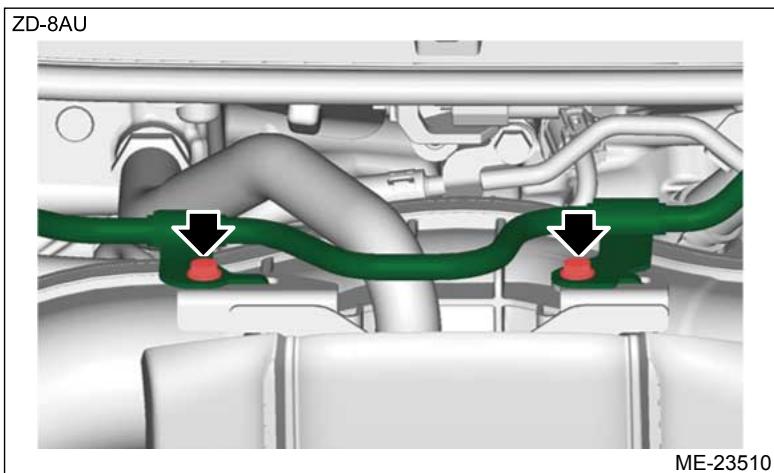
- LH side



11. Remove the clip securing the hose inlet assembly to the vehicle.

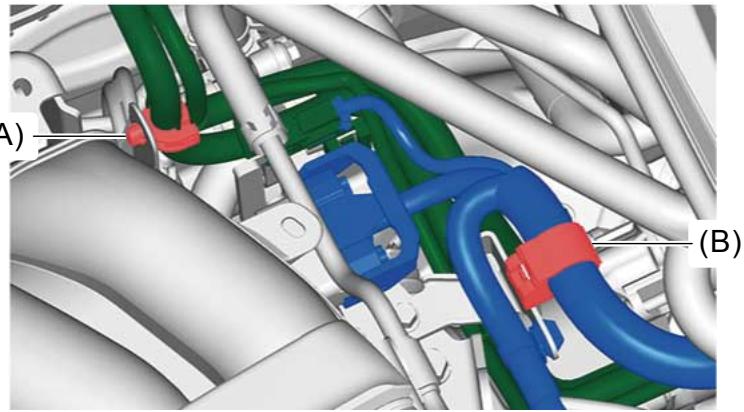


12. Remove the bolts which secure the brake vacuum pipe to the collector cover bracket No. 2.



13. Remove the clip (A) which secures the battery cable assembly to the intake manifold assembly, and remove the clip (B) which secures the bulkhead wiring harness to the engine rear hanger.

ZD-8AU



14. Lift the engine using ST1, ST2, ST3, ST4 and the shackle.

(1) Using the ST1, install the ST2 to the engine unit.

Preparation tool:

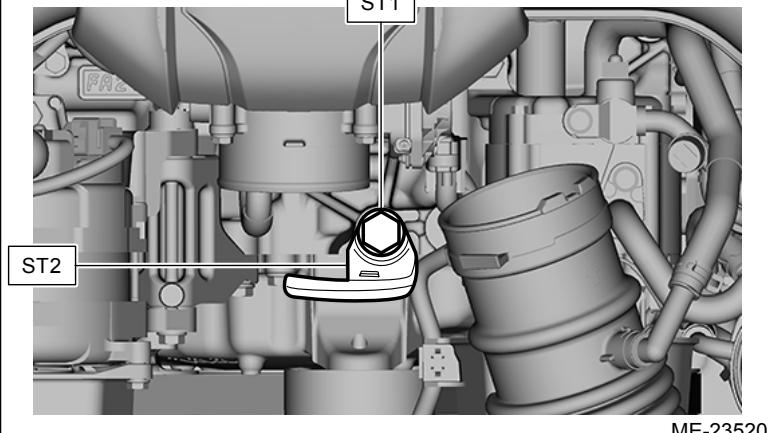
ST1: BOLT (90119-14120)

ST2: ENGINE HANGER NO.1 (12281-38150)

Tightening torque:

43 N·m (4.4 kgf-m, 31.7 ft-lb)

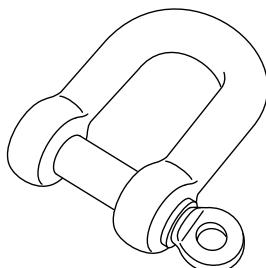
ZD-8AU



(2) Set the ST3, ST4, and the shackle to the vehicle.

Caution:

- Use a shackle with the load capacity of 250 kg (551 lb) or more.



FS-00325

- Set the ST3, ST4, and the shackle at the locations shown in the figure.

Preparation tool:

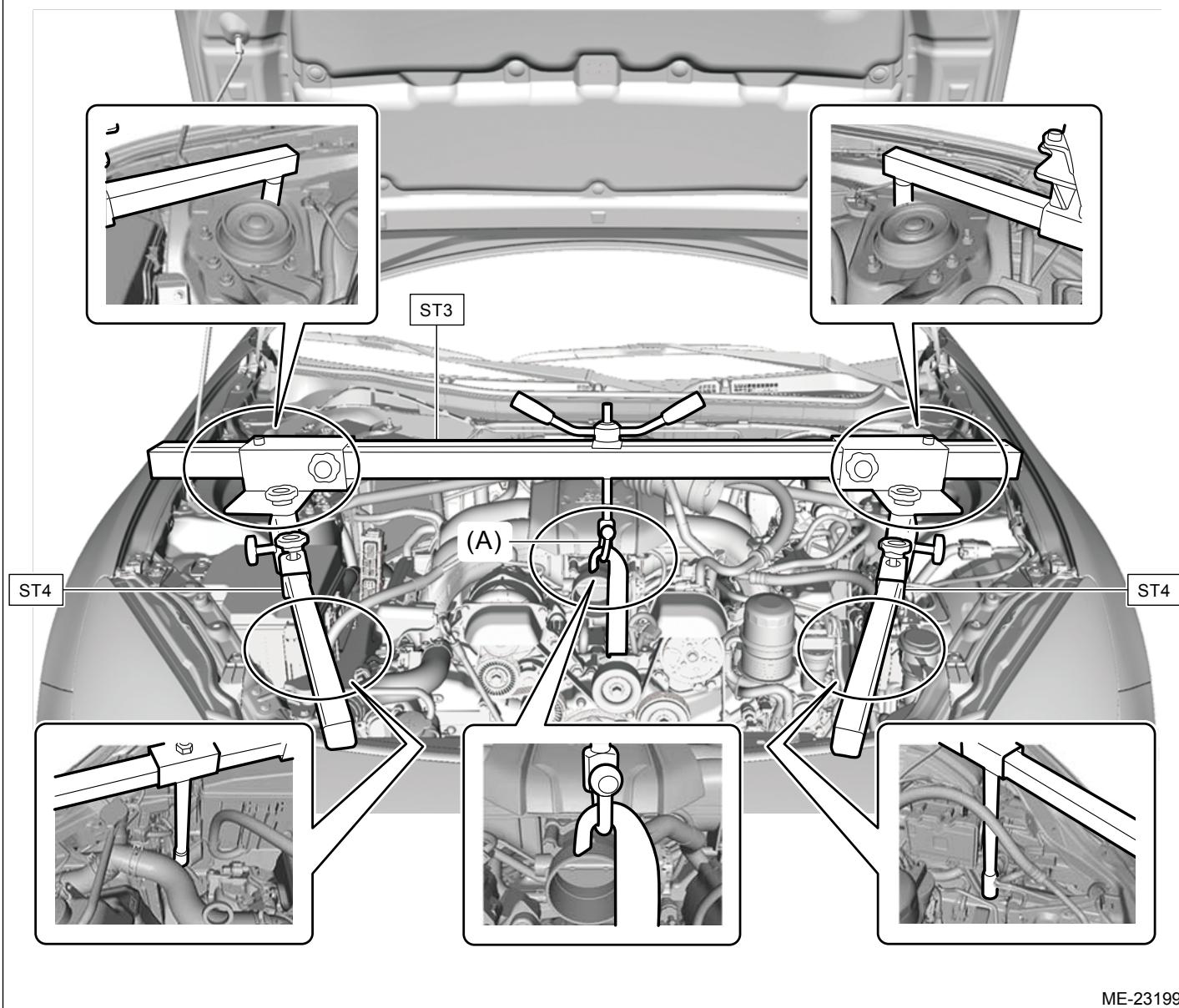
ST3: ENGINE HANGER (99099AJ000)

ST4: ADJUSTER (18679AA020)

General tool:

Shackle

ZD-8AU



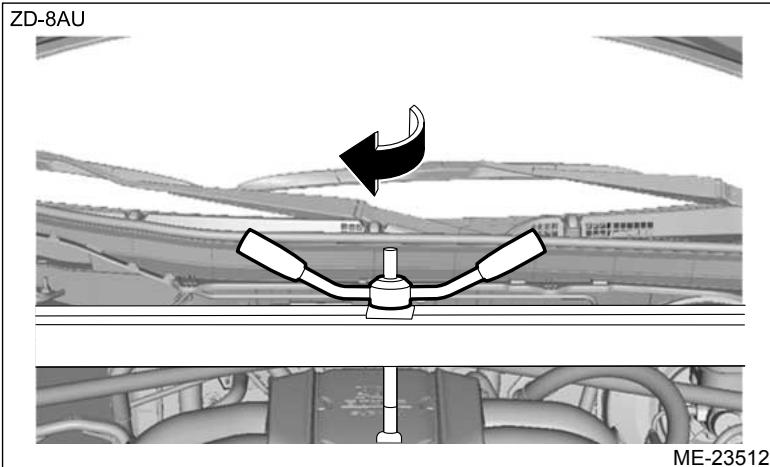
ME-23199

(A) Shackle

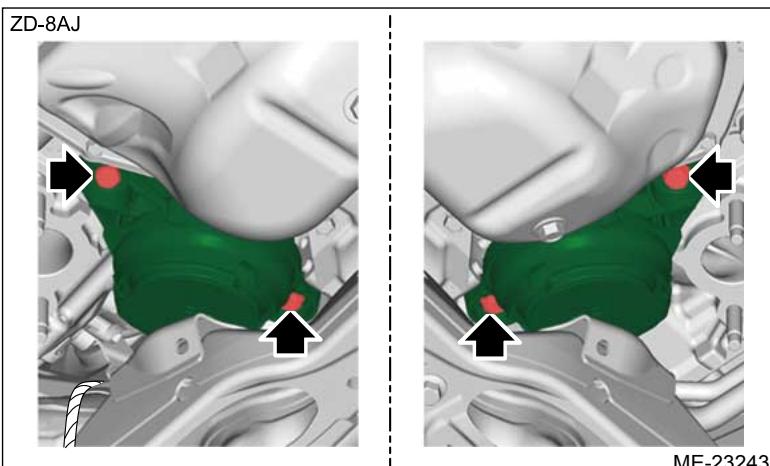
- (3) Turn the handle clockwise until the stud bolt of the engine mounting is pulled out from the engine mounting hole of the crossmember COMPL front, and lift the engine gradually.

Caution:

- To prevent damage to the threaded portion of the handle, apply grease or lubricants to the threaded portion before starting the work.
- When lifting up the engine unit, pay attention to the clearance of each part and be careful not to lift the engine too much, in order to prevent damaging the vehicle.
- When the engine unit is lifted, #4 part of the intake manifold assembly and hose pressure suction contact lightly. Insert a cloth, etc. between #4 part of the intake manifold assembly and hose pressure suction for protection.



15. Remove the engine mounting from the engine unit.



MECHANICAL(H4DO) > Engine Mounting

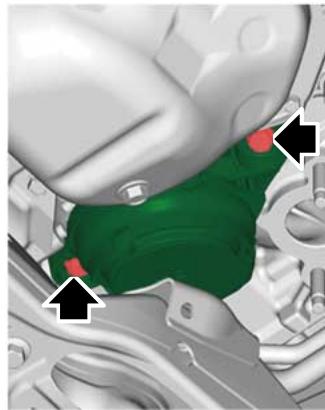
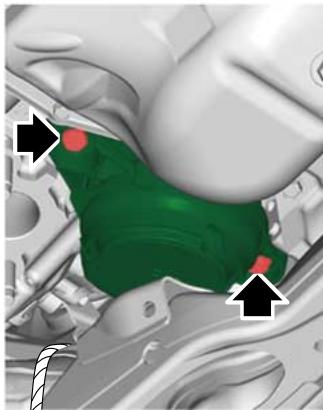
INSTALLATION

1. Install the engine mounting onto the engine.

Tightening torque:

35 N·m (3.6 kgf-m, 25.8 ft-lb)

ZD-8AJ



ME-23243

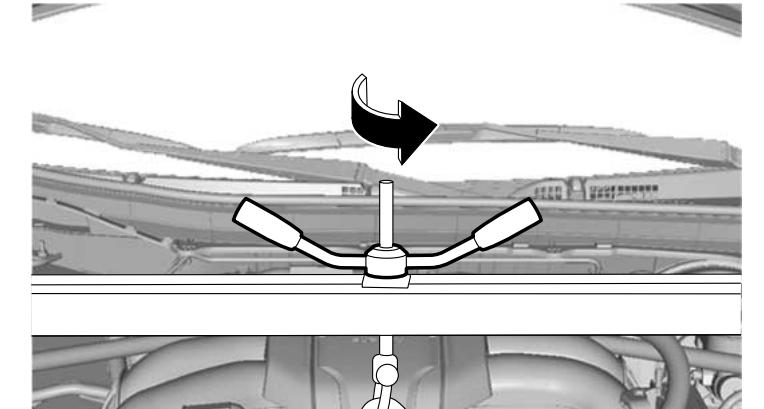
2. Lower the engine using ST1, ST2, ST3, ST4 and the shackle.

- 1) Turn the handle counterclockwise to lower the engine gradually and insert the stud bolt of the engine mounting into the engine mounting hole of the crossmember COMPL front.

Note:

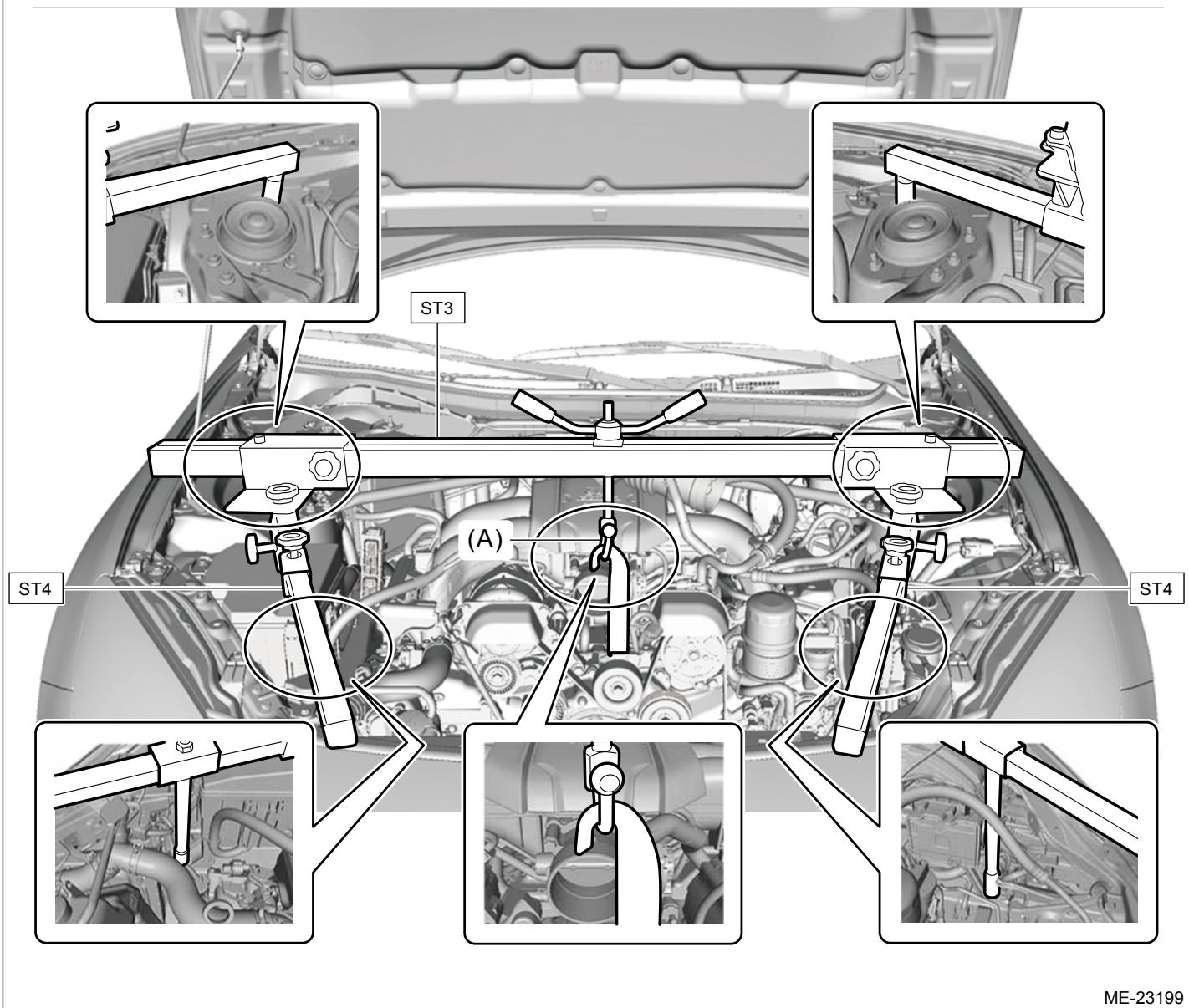
- If it is hard to insert the stud bolt of the engine mounting into the engine mounting hole of the crossmember COMPL front, lower the engine while lightly pushing it toward the rear of the vehicle.
- Check that the stud bolt of the engine mounting is securely inserted into the engine mounting hole of the crossmember COMPL front.

ZD-8AU



ME-23513

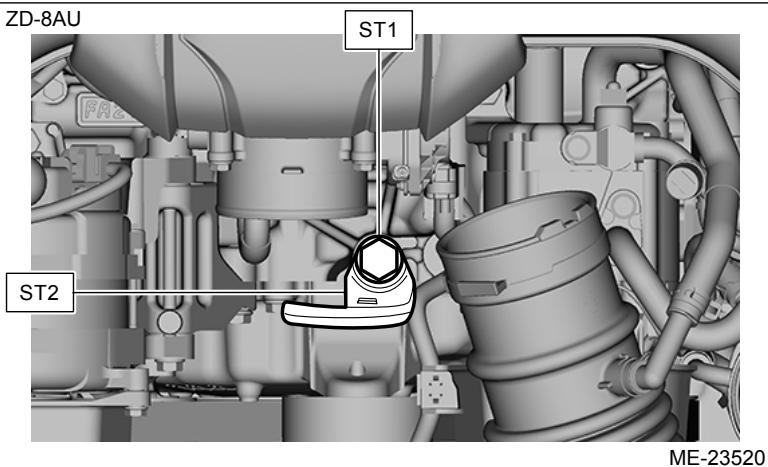
- 2) Remove ST3, ST4 and the shackle from the vehicle.



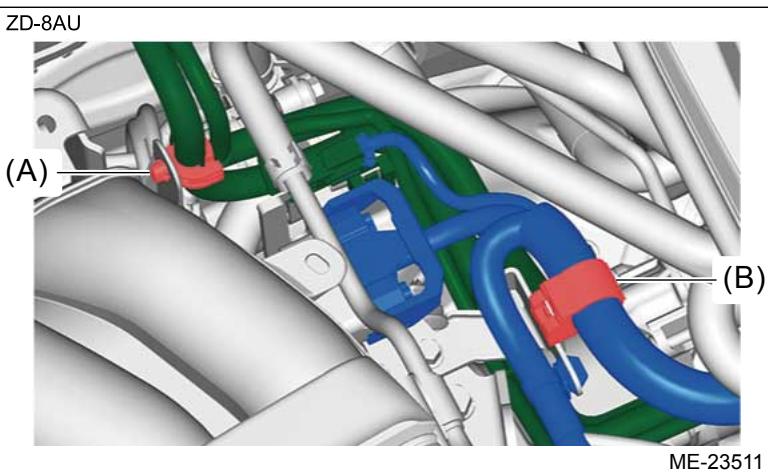
ME-23199

(A) Shackle

3) Remove the ST1 and ST2.



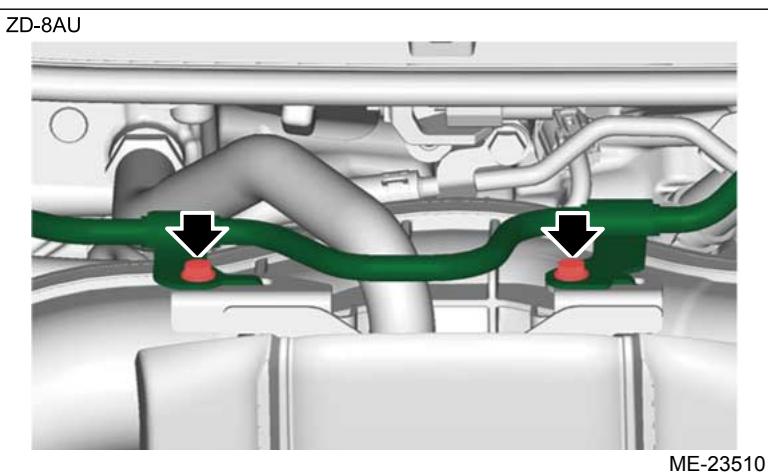
- 3.** Secure the bulkhead wiring harness to the engine rear hanger with clip (B), and secure the battery cable assembly to the intake manifold assembly with clip (A).



- 4.** Install the bolts which secure the brake vacuum pipe to the collector cover bracket No. 2.

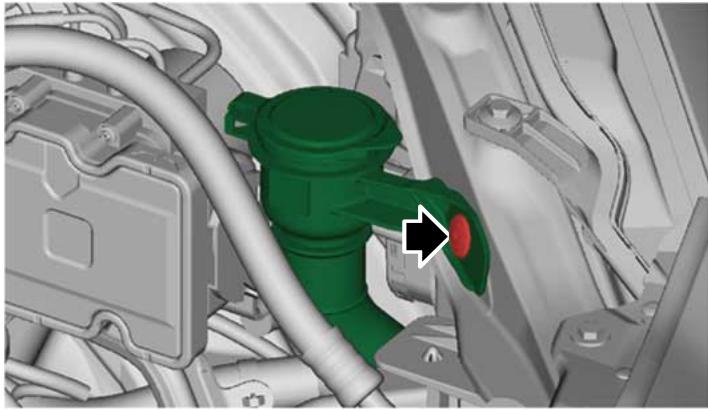
Tightening torque:

7.5 N·m (0.8 kgf-m, 5.5 ft-lb)



- 5.** Secure the hose inlet assembly to the vehicle with the clip.

ZD-8AU

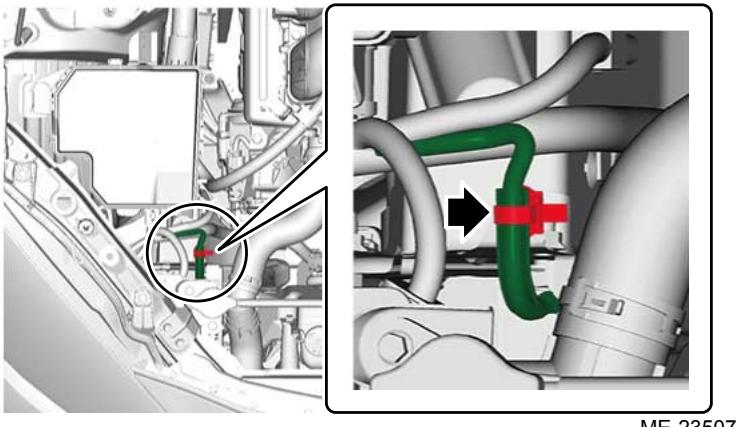


ME-23509

- 6.** Secure the bulkhead wiring harness to the vehicle with the clip.

- RH side

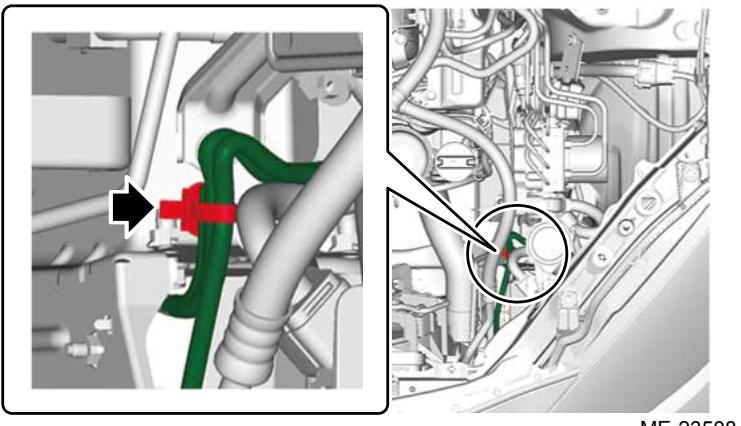
ZD-8AU



ME-23507

- LH side

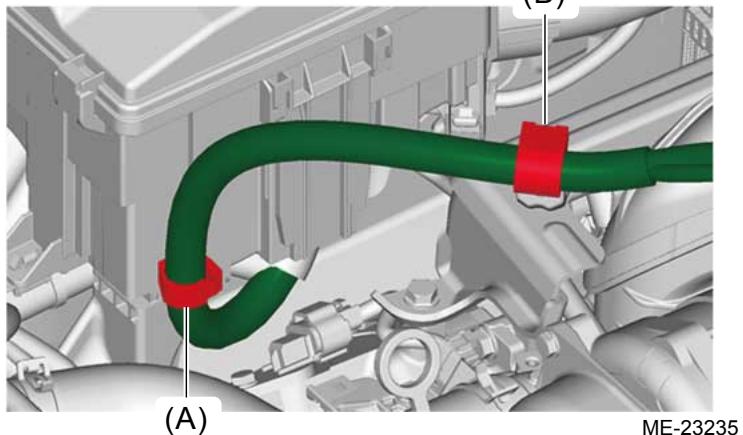
ZD-8AU



ME-23508

- 7.** Secure the generator cord to the fuel pipe protector RH No. 1 with clip (B), and secure the generator cord to the main fuse box with clip (A).

ZD-8AJ



8. Lift up the vehicle.
9. Install the nuts which hold the engine mounting to the crossmember COMPL front.

Caution:

Be sure to use a new nut.

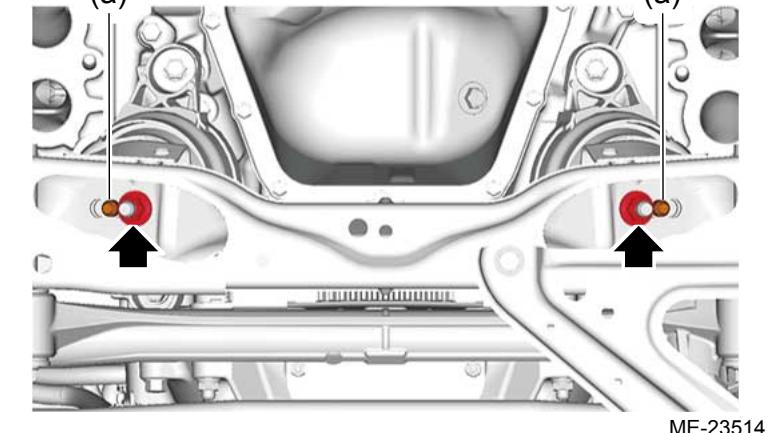
Note:

Make sure that locators (a) of the engine mounting are securely inserted.

Tightening torque:

90 N·m (9.2 kgf-m, 66.4 ft-lb)

ZD-8AU (a)



10. Install the front exhaust pipe. [Ref. to EXHAUST\(H4DO\)>Front Exhaust Pipe>INSTALLATION.](#)
11. Install the ECM. [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>Engine Control Module \(ECM\)>INSTALLATION.](#)
12. Install the air intake boot. [Ref. to INTAKE \(INDUCTION\)\(H4DO\)>Air Intake Boot>INSTALLATION.](#)
13. Connect the ground terminal to the battery sensor. [Ref. to REPAIR CONTENTS>NOTE > BATTERY.](#)
14. Set the panel COMPL front hood to the normal position. [Ref. to REPAIR CONTENTS>NOTE > STAY ASSEMBLY FRONT HOOD.](#)
15. Check the select lever and adjust it if necessary. (AT model)

Inspection:

[Ref. to CONTROL SYSTEMS>Select Lever>INSPECTION.](#)

Adjustment:

[Ref. to CONTROL SYSTEMS>Select Lever>ADJUSTMENT.](#)

Note:

This procedure is required because the select lever may be deviated from the adjusted position due to installation/removal of the nut on the engine mounting.

MECHANICAL(H4DO) > Engine Mounting

INSPECTION

Make sure that there are no cracks or other damages.

MECHANICAL(H4DO) > Preparation for Overhaul

PROCEDURE

1. After engine has been removed from the vehicle, mount the engine to the engine stand while being careful of the following.
 - (1) When mounting the engine stand, follow the instructions of engine stand used.
 - (2) Mount the engine stand using the points shown by the arrows in the figure.

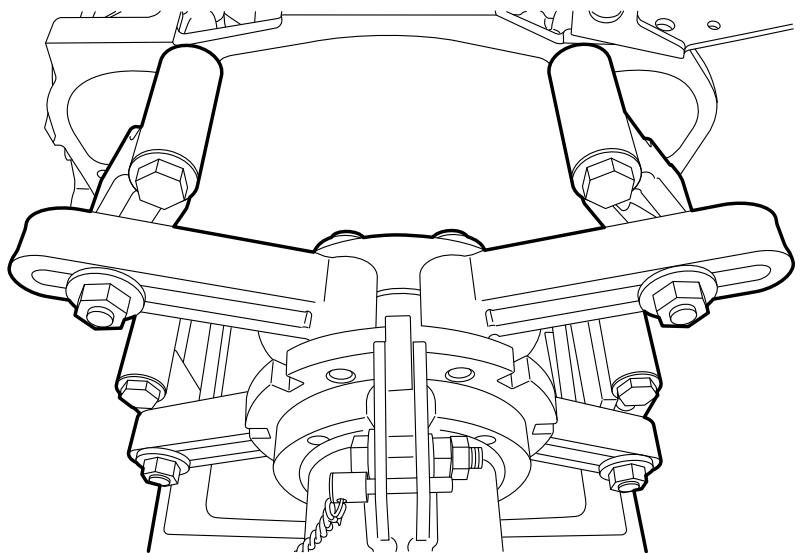
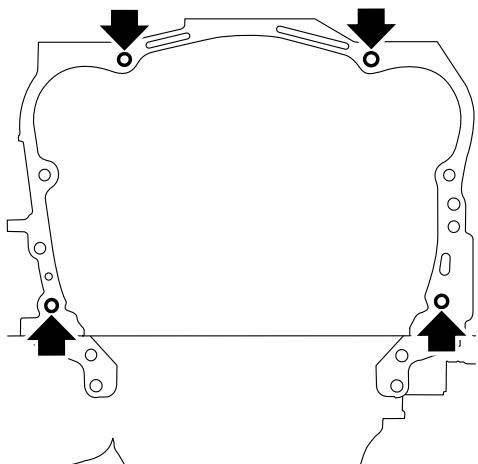
Caution:

Be sure to mount the engine stand at four points. Otherwise, the engine damage may occur.

Note:

The engine stand shown in the figure is just for reference.

ZD-8AJ



ME-23245

2. In this section the procedures described under each index are all related to each other and described in order. The procedure for overhauling of the engine will be completed when you go through all steps in the process.

Therefore, in this section, to conduct the particular procedure within the flow of a section, you need to go back and conduct the procedure described previously in order to do that particular procedure.

MECHANICAL(H4DO) > Vacuum Pump

REMOVAL

Caution:

When working on the vehicle, be careful not to spill engine oil on the exhaust pipe. If engine oil is spilt onto the exhaust pipe, wipe it off with cloth to avoid emission of smoke or causing a fire.

Note:

When replacing a single part, perform the work with the engine assembly installed to body.

1. When working on the vehicle

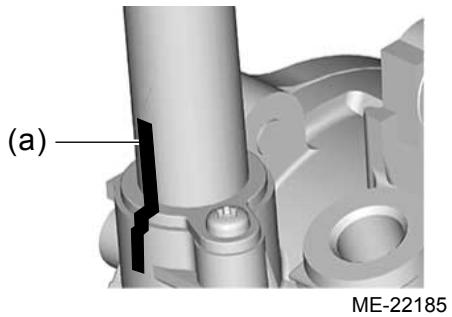
Note:

When working on the vehicle, perform the following steps also.

- (1) Remove the strut tower bar RH.  Ref. to FRONT SUSPENSION>Strut Tower Bar>REMOVAL.
- (2) Disconnect the brake booster vacuum hose (A) from the vacuum pump, and place it aside so that it does not interfere with the work.

Note:

Before disconnecting the brake booster vacuum hose, use a marker to put an alignment mark (a) at the position shown in the figure when the clip is slid.



- (3) Disconnect the connector (B) from ECM.

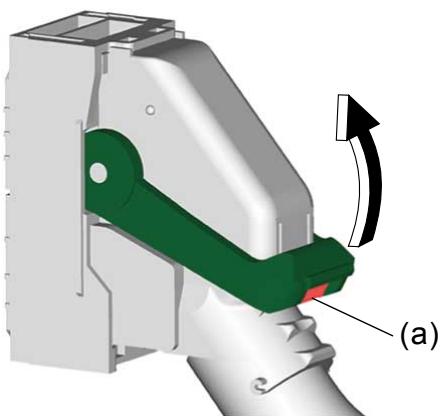
Caution:

Make sure that the lock is released before moving the lever in order to avoid damaging the connector.

Note:

To disconnect the connector, press the portion (a) shown in the figure to release the lock and move the lever in the direction of arrow.

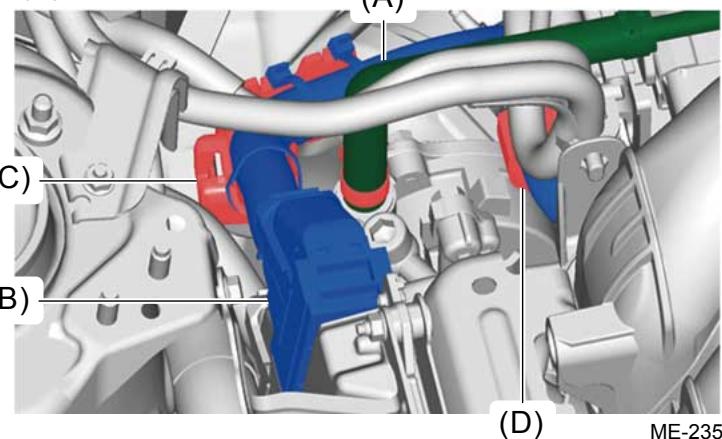
SK-5CJ



ME-22826

- (4) Remove the clip (C) and clip (D) securing the engine wiring harness to the vehicle and engine rear hanger, and place them aside so that they do not interfere with work.

ZD-8AU



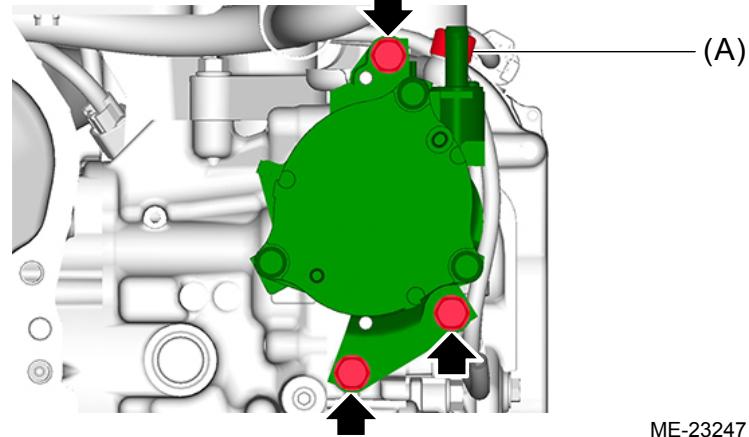
ME-23515

2. Remove the union bolt (A) securing the oil pipe (vacuum pump), and remove the vacuum pump.

Note:

The vacuum pump cannot be disassembled.

ZD-8AJ



ME-23247

3. Remove liquid gasket from the vacuum pump mounting surface of the engine, and the surface of the

vacuum pump.

MECHANICAL(H4DO) > Vacuum Pump

INSTALLATION

1. Apply liquid gasket to the vacuum pump as shown in the figure.

Note:

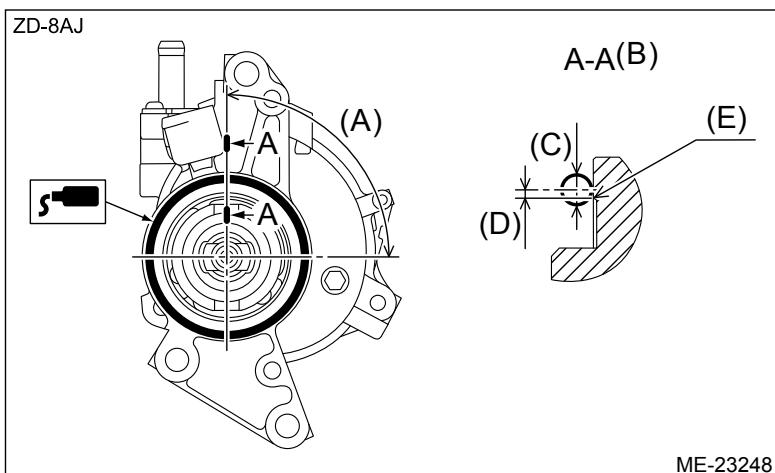
- Before applying liquid gasket, degrease the old liquid gasket seal surface of the engine where the vacuum pump is mounted on, and the surface of the vacuum pump.
- When applying liquid gasket, the start and the end of application should cross at the point within the range A shown in the figure.
- Install within 5 min. after applying liquid gasket.

Preparation items:

Liquid gasket: THREE BOND 1217G (part No. K0877Y0100), THREE BOND 1217H or equivalent

Liquid gasket applying diameter:

3 ± 1 mm (0.1181 ± 0.0394 in)

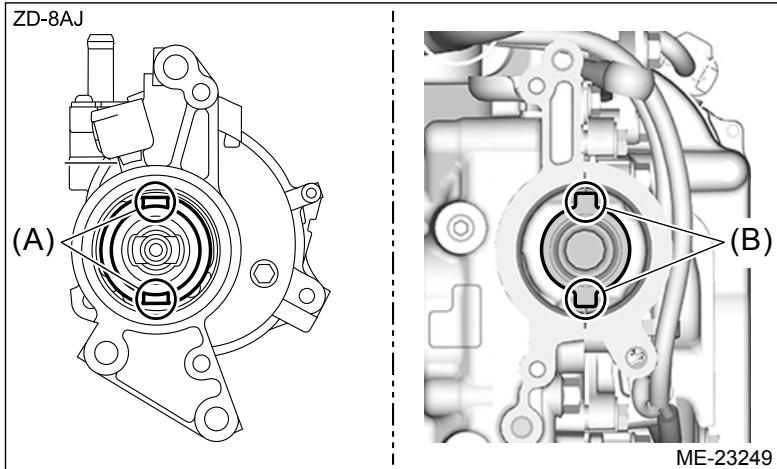


- | | | |
|---|---|------------------|
| (A) Range A (range where application can start) | (C) $\phi3\pm1$ mm
(0.1181 ± 0.0394 in) | (E) Chamfer edge |
| (B) Liquid gasket applying position of mating surface | (D) Within 1 mm (0.0394 in) | |

2. Install the vacuum pump.

Note:

When installing the vacuum pump, align the slot on the vacuum pump shaft (A) with the protrusion on the intake camshaft RH (B).



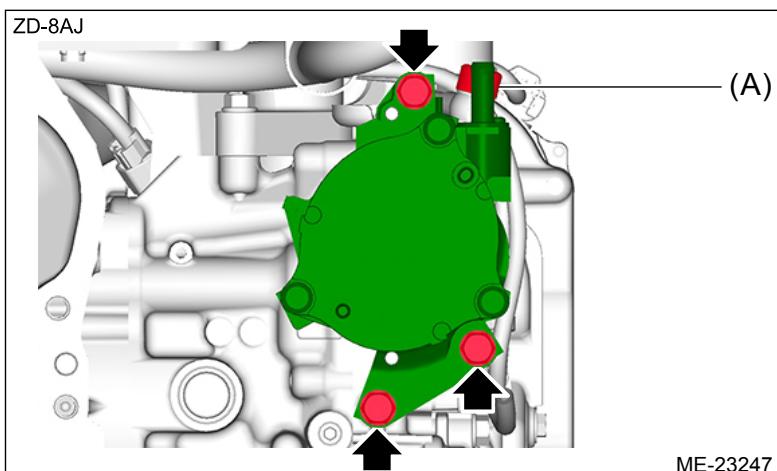
Tightening torque:

16 N·m (1.6 kgf-m, 11.8 ft-lb)

3. Apply engine oil to the threaded portion for the vacuum pump union bolt.
4. Set a new gasket on the oil pipe, and secure the oil pipe with the union bolt (A).

Tightening torque:

20 N·m (2.0 kgf-m, 14.8 ft-lb)



5. When working on the vehicle

Note:

When working on the vehicle, perform the following steps also.

- (1) Place the engine wiring harness and secure the engine wiring harness to the vehicle and engine rear hanger with the clip (D) and clip (C).
- (2) Connect the connector (B) to ECM.

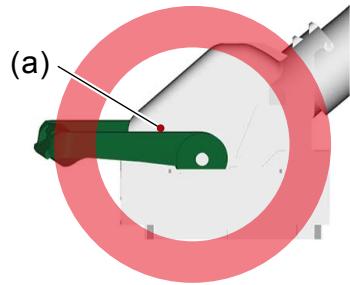
Caution:

To prevent damage to the connector, when connecting the connector, insert the connector straight in until it stops, and while maintaining the position, lock the lever.

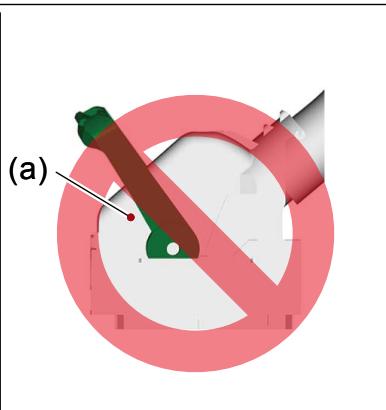
Note:

When connecting the connector, check that the lever is located at the position shown in the figure (position beyond the lock portion (a)).

SK-5CJ



O=OK



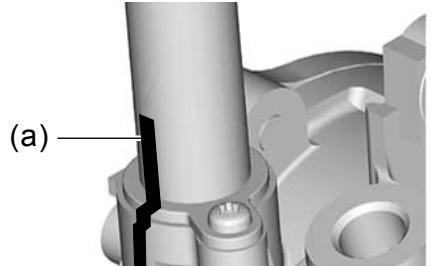
Ø=NG

ME-22837

- (3) Place the brake booster vacuum hose (A), and connect the brake booster vacuum hose (A) to the vacuum pump.

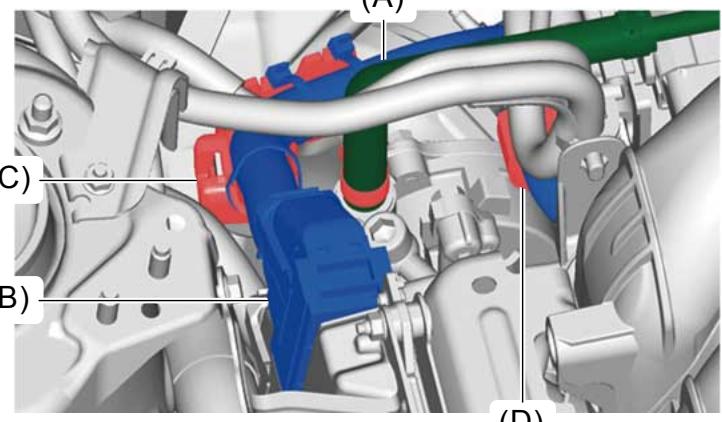
Note:

When connecting the brake booster vacuum hose, align the alignment marks (a) on the vacuum pump and the brake booster vacuum hose.



ME-22185

ZD-8AU



ME-23515

- (4) Install the strut tower bar RH. [Ref. to FRONT SUSPENSION>Strut Tower Bar>INSTALLATION.](#)

MECHANICAL(H4DO) > Vacuum Pump

INSPECTION

Check that the vacuum pump has no deformation, cracks or other damages.

MECHANICAL(H4DO) > V-belt

REMOVAL

Note:

When replacing a single part, perform the work with the engine assembly installed to body.

1. V-BELT

1. When working on the vehicle

Note:

When working on the vehicle, perform the following steps also.

- (1) Perform the steps below to remove the air intake boot, and place it aside so that it does not interfere with the work.

Caution:

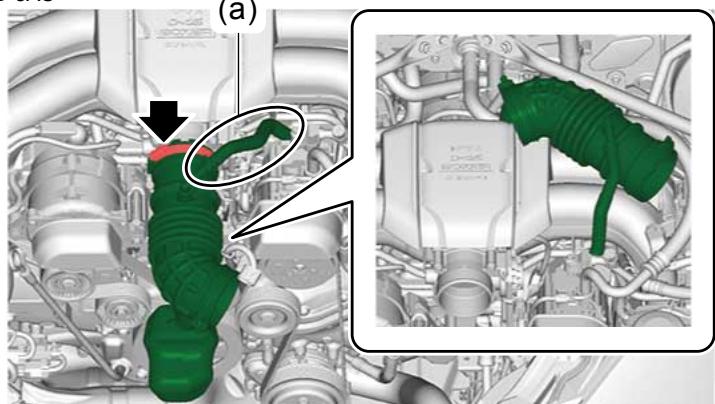
Do not remove the PCV hose No. 2 (a).

- 1) Remove the air cleaner case. [Ref. to INTAKE_\(INDUCTION\)\(H4DO\)>Air Cleaner Case>REMOVAL.](#)
- 2) Loosen the clamp, remove the air intake boot, and place it aside so that it does not interfere with the work.

Caution:

Be careful not to pull out the PCV hose No. 2 (a).

ZD-8AU

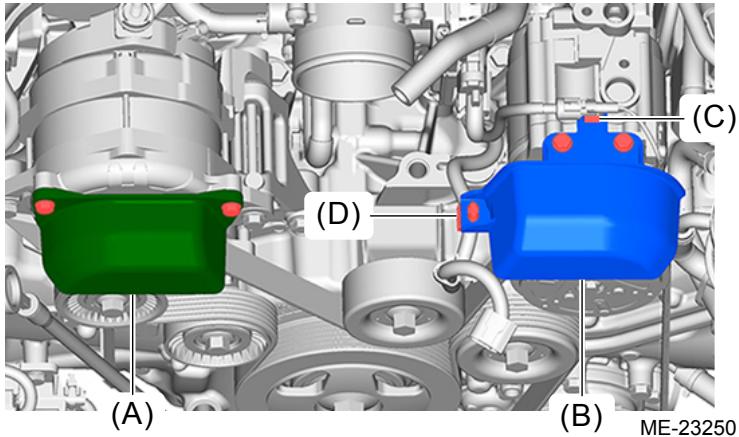


IN-10776

2. Remove the V-belt covers.

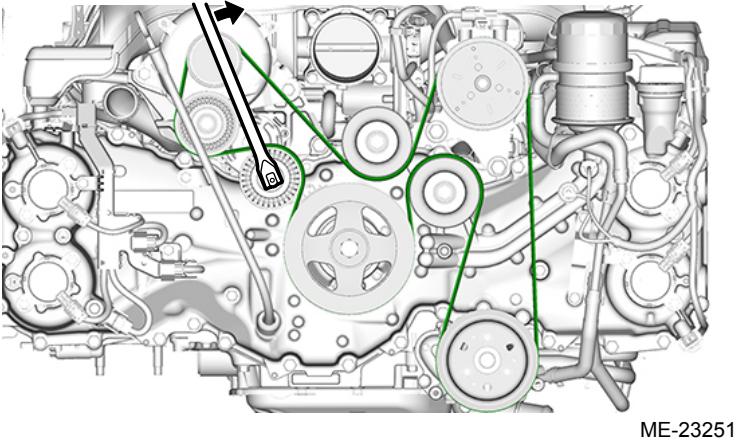
- (1) Remove the V-belt cover RH (A).
- (2) Remove the clip (C) securing the connector of the A/C compressor from the V-belt cover LH (B).
- (3) Remove the clip (D) securing the engine wiring harness from the V-belt cover LH (B) and remove the V-belt cover LH (B).

ZD-8AJ



3. Attach the tool to the V-belt tensioner assembly, and rotate the tool clockwise to loosen and remove the V-belt.

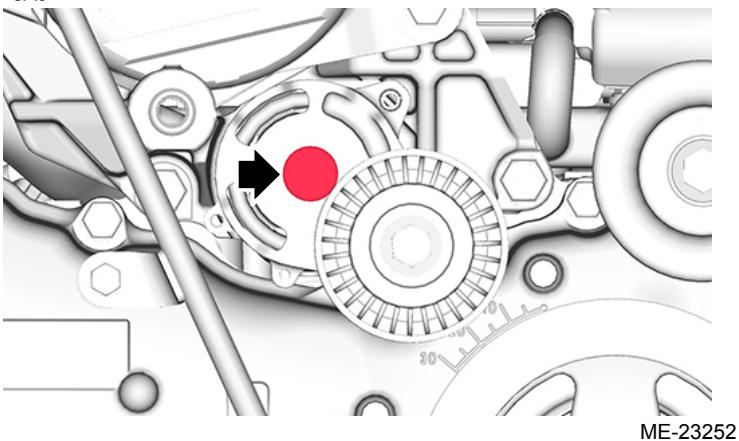
ZD-8AJ



2. V-BELT TENSIONER ASSEMBLY

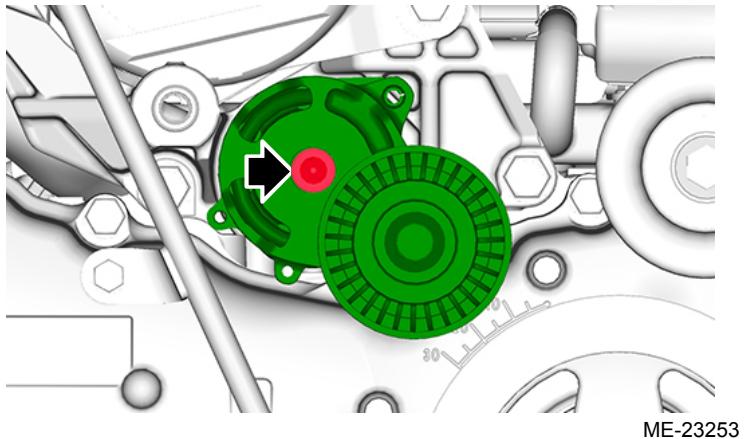
1. Remove the V-belts. [Ref. to MECHANICAL\(H4DO\)>V-belt>REMOVAL > V-BELT.](#)
2. Remove the idler pulley No. 1. [Ref. to MECHANICAL\(H4DO\)>V-belt>REMOVAL > IDLER PULLEY.](#)
3. Remove the cap from V-belt tensioner assembly.

ZD-8AJ



4. Remove the bolt securing the V-belt tensioner assembly to the generator bracket, and remove the V-belt tensioner assembly.

ZD-8AJ

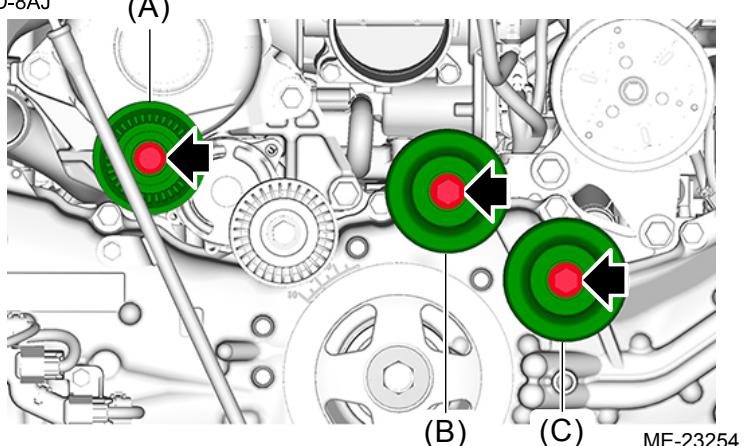


3. IDLER PULLEY

1. Remove the V-belts. Ref. to MECHANICAL(H4DO)>V-belt>REMOVAL > V-BELT.
2. Remove the bolts which secure the idler pulley to the generator bracket and chain cover, and remove the idler pulley.

ZD-8AJ

(A)



(A) Idler pulley No. 1

(B) Idler pulley No. 2

(C) Idler pulley No. 3

MECHANICAL(H4DO) > V-belt

INSTALLATION

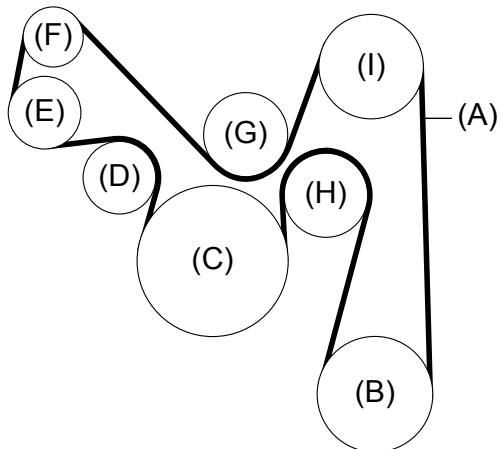
1. V-BELT

1. Attach the tool to the V-belt tensioner assembly, and rotate the tool clockwise to remove the V-belt as shown in the figure.

Caution:

- When reusing the V-belt, wipe off dust and water with cloth.
- Do not use the V-belt if there is any oil, grease or coolant on the belt.
- Be careful not to rub the V-belt end surface with bare hands; exposed core may cause injury.
- Wipe off any dust, oil and water on the groove of each pulley with cloth.

ZD-8AJ



ME-23255

- | | | |
|-----------------------|---------------------------|---------------------------|
| (A) V-belt | (D) V-belt tensioner ASSY | (G) Idler pulley No. 2 |
| (B) Water pump pulley | (E) Idler pulley No. 1 | (H) Idler pulley No. 3 |
| (C) Crank pulley | (F) Generator pulley | (I) A/C compressor pulley |

2. Install the V-belt cover.

- (1) Install the V-belt cover LH (B) and secure the engine wiring harness to the V-belt cover LH (B) with clip (D).

Tightening torque:

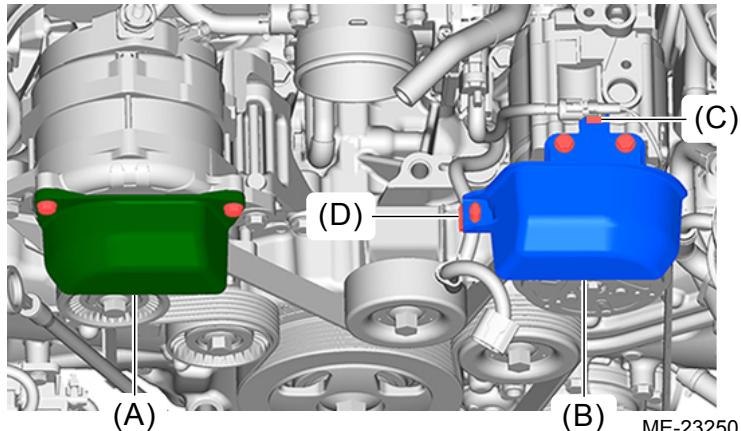
6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

- (2) Secure the connector of the A/C compressor to the V-belt cover LH (B) with clip (C).
- (3) Install the V-belt cover RH (A).

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

ZD-8AJ



ME-23250

3. When working on the vehicle

Note:

When working on the vehicle, perform the following steps also.

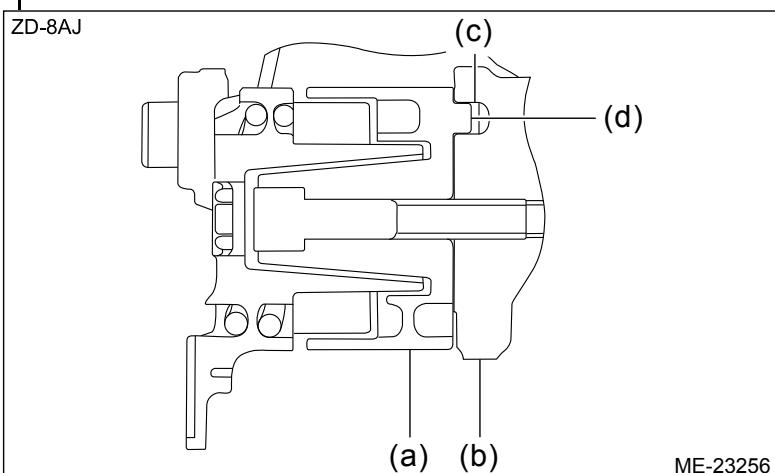
- (1) Install the air intake boot.  Ref. to INTAKE (INDUCTION)(H4DO)>Air Intake Boot>INSTALLATION.

2. V-BELT TENSIONER ASSEMBLY

1. Install the V-belt tensioner assembly onto the generator bracket.

Note:

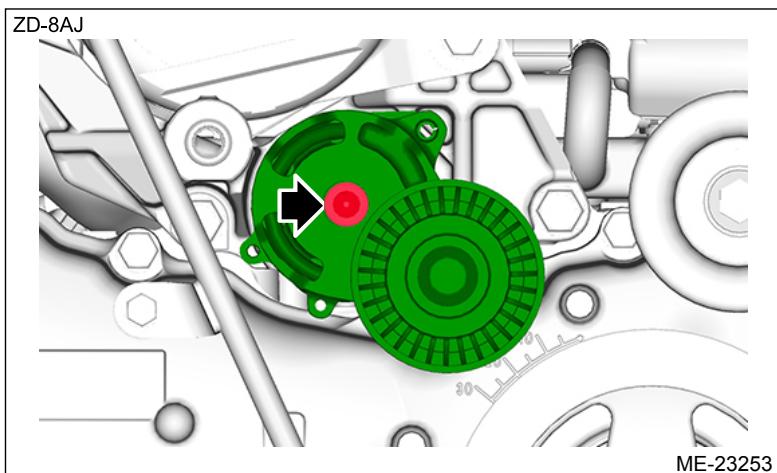
When installing the V-belt tensioner assembly, insert the protrusion of V-belt tensioner assembly into the hole for preventing rotation at the generator bracket.



(a) V-belt tensioner ASSY (c) Hole to prevent rotation (d) Protrusion portion
(b) Generator bracket

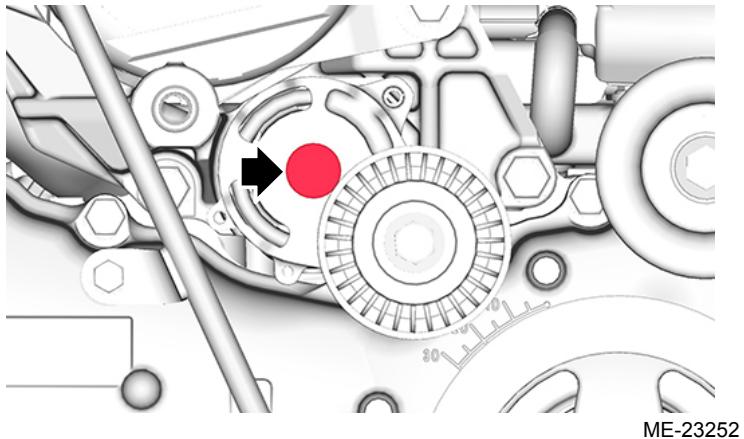
Tightening torque:

25 N·m (2.5 kgf-m, 18.4 ft-lb)



- 2.** Install the cap to the V-belt tensioner assembly.

ZD-8AJ



ME-23252

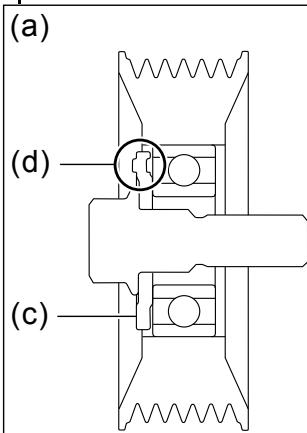
3. Install the idler pulley No. 1. Ref. to MECHANICAL(H4DO)>V-belt>INSTALLATION > IDLER PULLEY.
4. Install the V-belts. Ref. to MECHANICAL(H4DO)>V-belt>INSTALLATION > V-BELT.

3. IDLER PULLEY

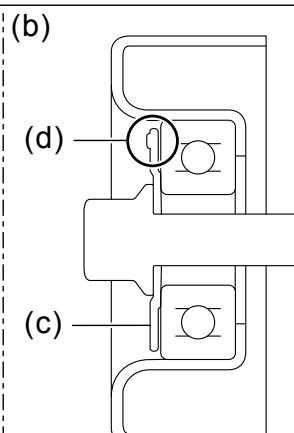
1. Install the idler pulley to the generator bracket and chain cover.

Note:

When installing the idler pulley, be careful of the idler pulley cover direction.



ZD-8AJ



ME-23257

(a) Generator bracket part

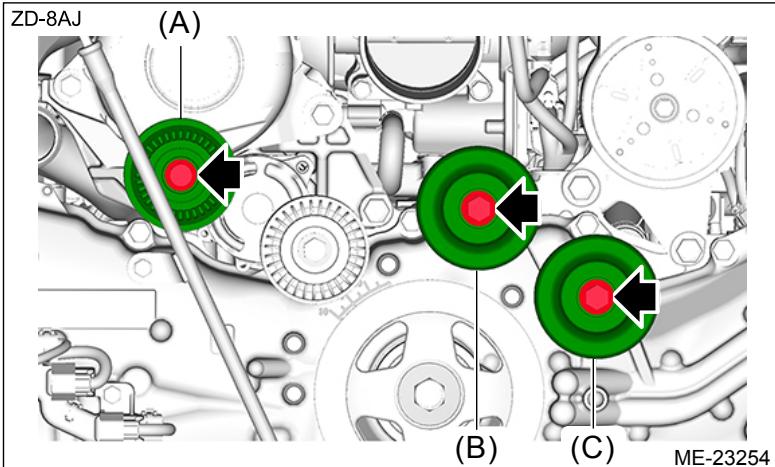
(b) Chain cover part

(c) Idler pulley cover

(d) Protrusion (3 places)

Tightening torque:

36 N·m (3.7 kgf-m, 26.6 ft-lb)



(A) Idler pulley No. 1

(B) Idler pulley No. 2

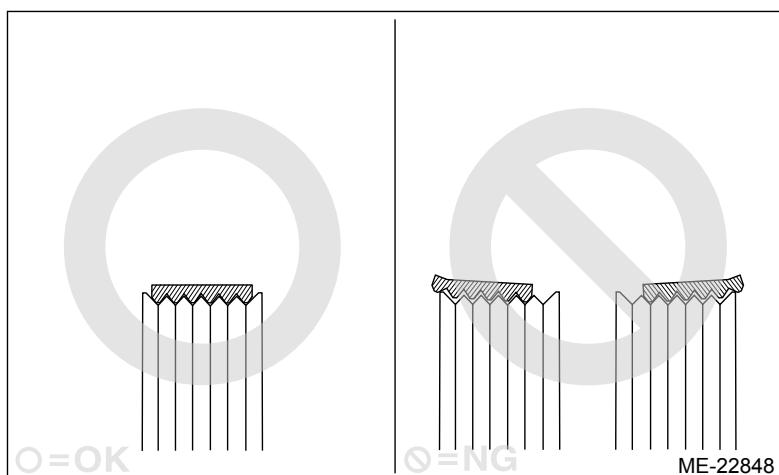
(C) Idler pulley No. 3

2. Install the V-belts. [Ref. to MECHANICAL\(H4DO\)>V-belt>INSTALLATION > V-BELT.](#)

MECHANICAL(H4DO) > V-belt

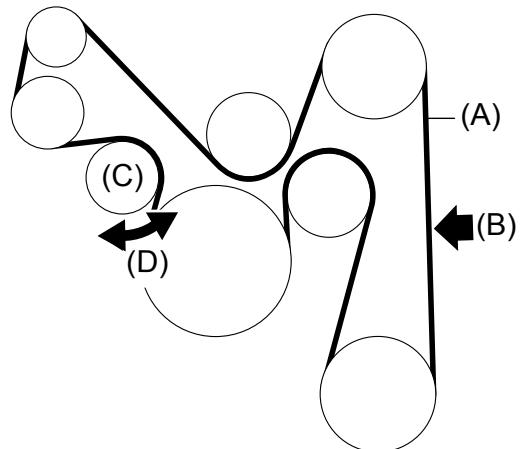
INSPECTION

1. Check the V-belt for cracks, tear or wear.
2. Check the V-belt tensioner assembly and V-belt tensioner bracket for deformation, cracks and any other damage.
3. Check that the V-belt ribs are securely placed on the rib grooves for each pulley.



4. Check that the V-belt tensioner assembly (C) moves in the direction of arrow (D), when the V-belt (A) is pushed and released by the area indicated by the arrow (B).

ZD-8AJ



ME-23258

5. Start the engine and confirm that the V-belt rotates smoothly and no abnormal noise is emitted.

MECHANICAL(H4DO) > Crank Pulley

REMOVAL



SUBARU
SST

Note:

When replacing a single part, perform the work with the engine assembly installed to body.

1. When working on the vehicle

Note:

When working on the vehicle, perform the following steps also.

- (1) Perform the steps below to remove the air intake boot, and place it aside so that it does not interfere with the work.

Caution:

Do not remove the PCV hose No. 2 (a).

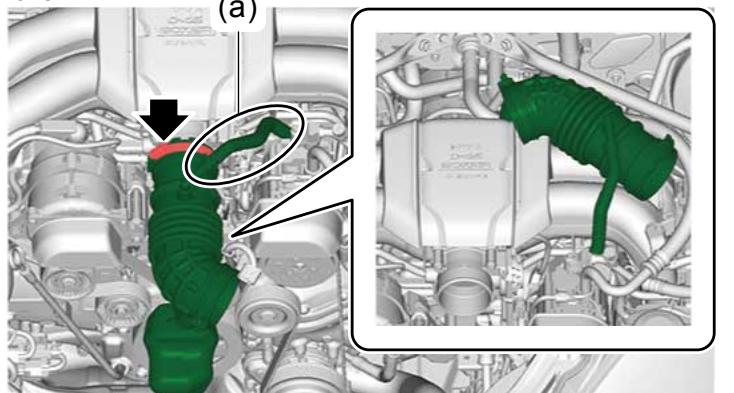
1) Remove the air cleaner case. [Ref. to INTAKE \(INDUCTION\)\(H4DO\)>Air Cleaner Case>REMOVAL.](#)

2) Loosen the clamp, remove the air intake boot, and place it aside so that it does not interfere with the work.

Caution:

Be careful not to pull out the PCV hose No. 2 (a).

ZD-8AU



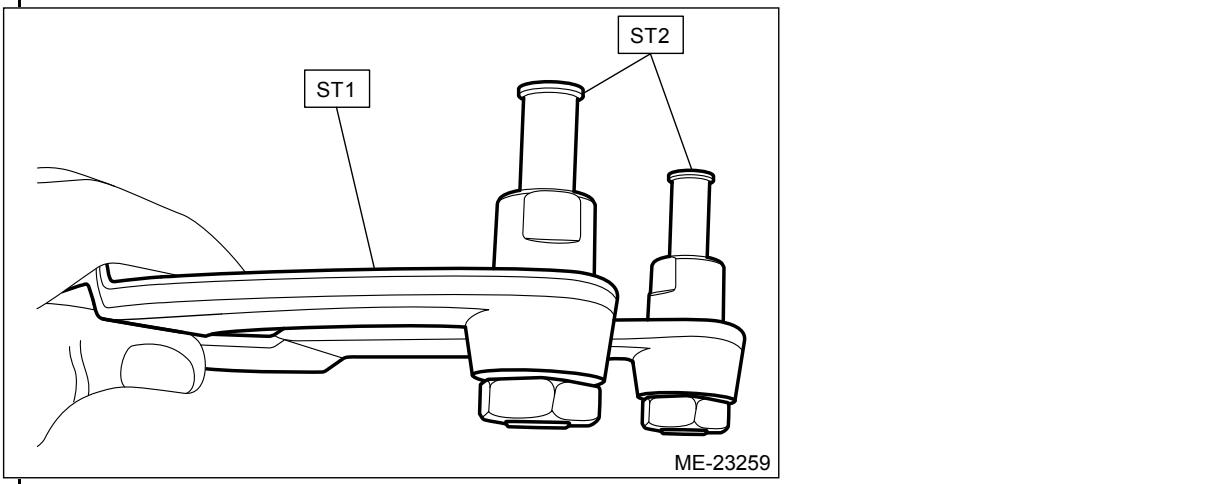
IN-10776

2. Remove the V-belts. [Ref. to MECHANICAL\(H4DO\)>V-belt>REMOVAL > V-BELT.](#)

3. Use the ST1 and ST2 to lock the crank pulley, remove the crank pulley bolt.

Note:

To prevent damaging ST1, attach the ST2 onto the ST1 as shown in the figure.

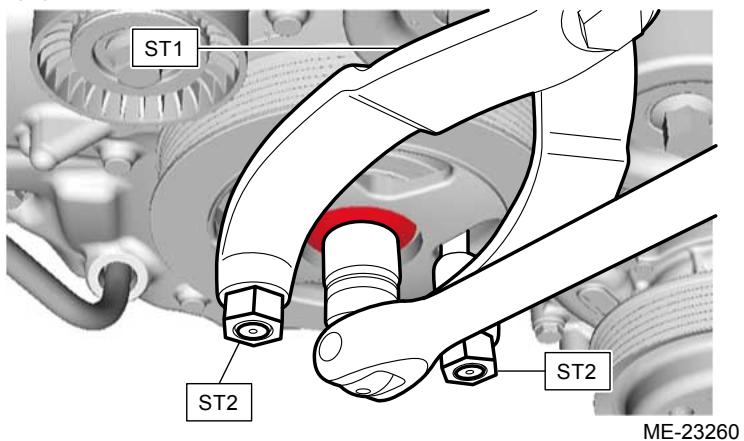


Preparation tool:

ST1: PULLEY WRENCH (18355AA000)

ST2: PULLEY WRENCH PIN SET (18334AA000)

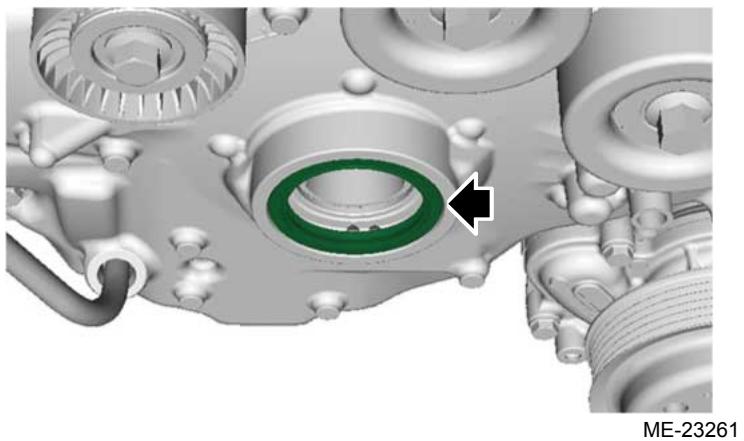
ZD-8AJ



4. Remove the crank pulley.

5. Remove the front oil seal from the chain cover.

ZD-8AJ



INSTALLATION

1. Degrease the press-fit section for the chain cover front oil seal, and install a new front oil seal to the chain cover using a special tool (ST).

Caution:

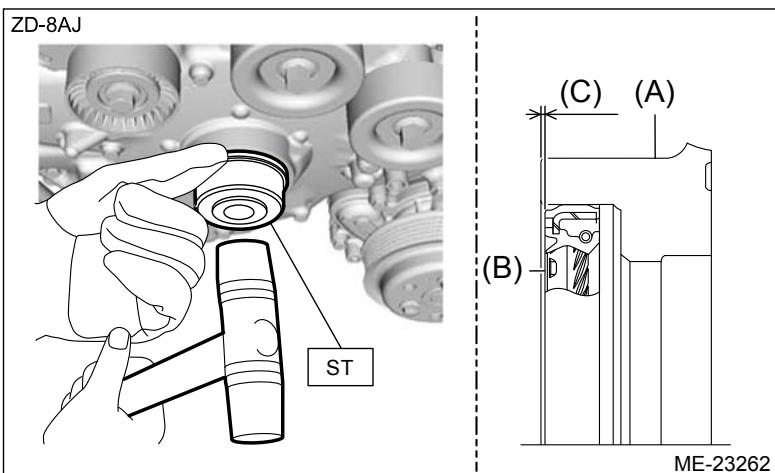
Do not apply fluid such as engine oil to the front oil seal and the chain cover; otherwise engine oil leakage may occur.

Preparation tool:

ST: SPECIAL TOOL B (41399FG020)

Front oil seal press-fit position:

1^{+0}_{-1} mm ($0.0394^{+0}_{-0.0394}$ in) position from chain cover end face



(A) Chain cover

(B) Oil seal

(C) Front oil seal press-fit position

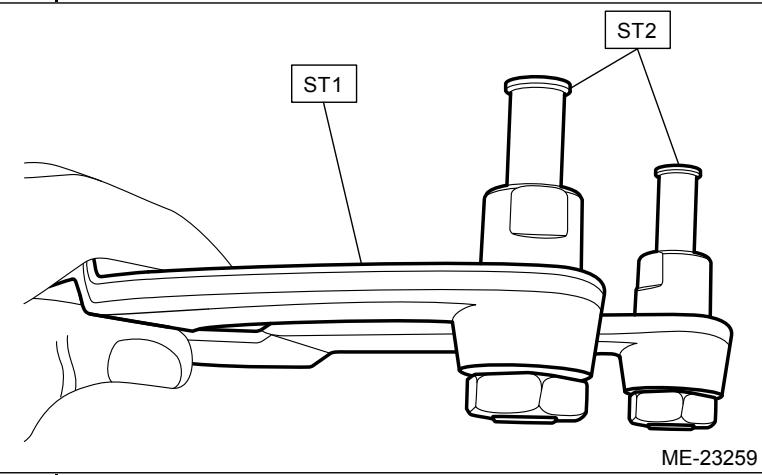
1^{+0}_{-1} mm ($0.0394^{+0}_{-0.0394}$

in) position from chain cover
end face)

2. Clean the crankshaft thread using compressed air.
3. Apply engine oil to the crank pulley bolt seat and thread.
4. Install the crank pulley.
 - (1) Set the crank pulley to the chain cover.
 - (2) Use the ST1 and ST2 to lock the crank pulley, and temporarily tighten the crank pulley bolt.

Note:

To prevent damaging ST1, attach the ST2 onto the ST1 as shown in the figure.



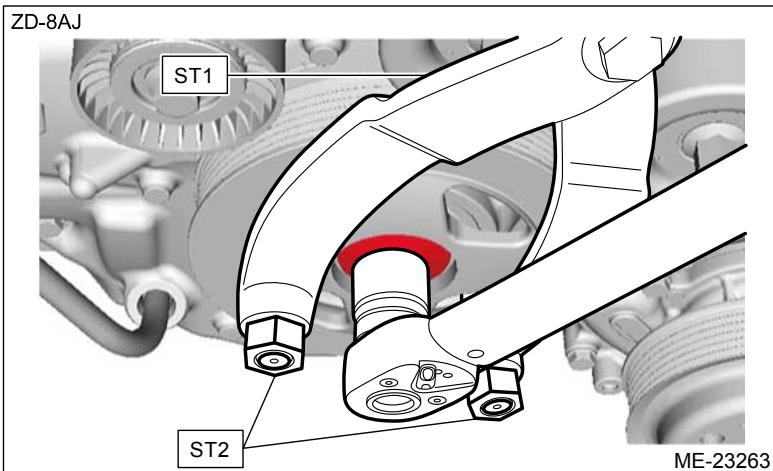
Preparation tool:

ST1: PULLEY WRENCH (18355AA000)

ST2: PULLEY WRENCH PIN SET (18334AA000)

Tightening torque:

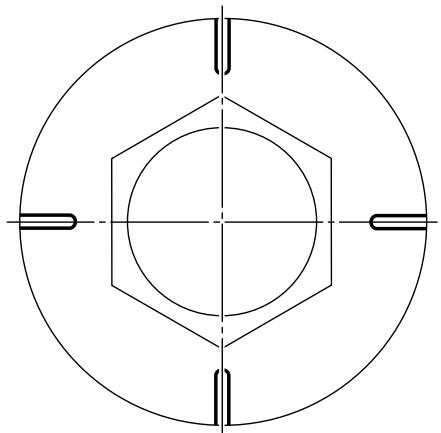
40 N·m (4.1 kgf-m, 29.5 ft-lb)



- (3) Use the marker as shown in the figure, draw the reference line (A) on the crank pulley bolt according to the indented line on the crank pulley bolt head, and draw the end line (B) on the crank pulley.

Note:

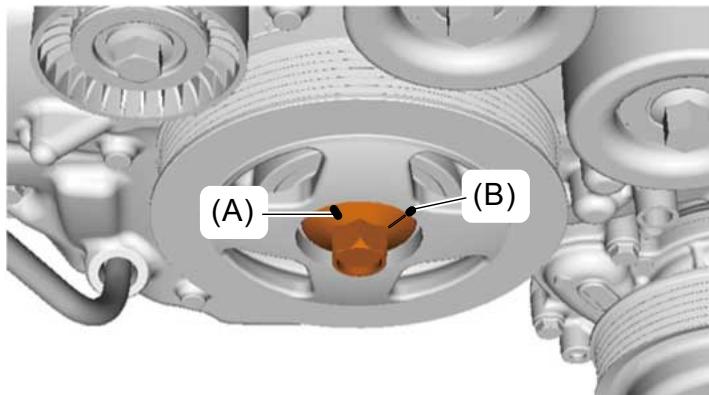
- Lines are indented by 90° on the crank pulley bolt head.



ME-22859

- Reference line is drawn for better visibility.

ZD-8AJ



ME-23264

- (4) Use the ST1 and ST2 to lock the crank pulley, and tighten the crank pulley bolt until the reference line (A) and end line (B) are aligned.

Note:

It should be approx. 90° when reference line (A) and end line (B) are aligned.

Preparation tool:

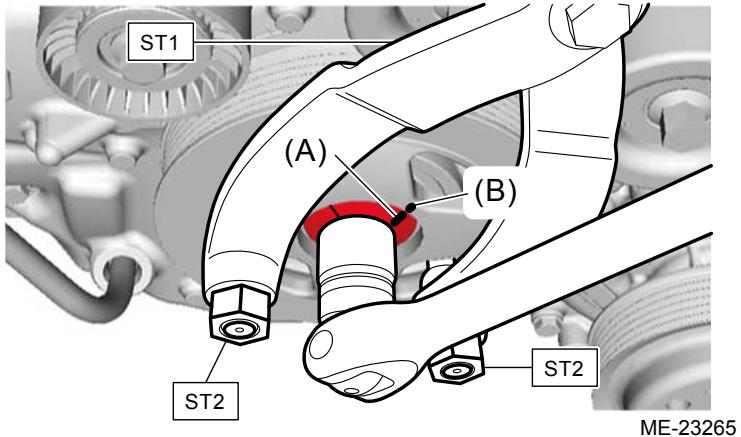
ST1: PULLEY WRENCH (18355AA000)

ST2: PULLEY WRENCH PIN SET (18334AA000)

Tightening angle:

$90^\circ \pm 5^\circ$

ZD-8AJ



5. Install the V-belts. [Ref. to MECHANICAL\(H4DO\)>V-belt>INSTALLATION > V-BELT.](#)

6. When working on the vehicle

Note:

When working on the vehicle, perform the following steps also.

(1) Install the air intake boot. [Ref. to INTAKE \(INDUCTION\)\(H4DO\)>Air Intake Boot>INSTALLATION.](#)

MECHANICAL(H4DO) > Crank Pulley

INSPECTION

1. Check that the crank pulley has no deformation, cracks or other damages.
2. Inspect for oil leakage from the front oil seal. If there is an oil leak, replace the front oil seal with a new one.
 - [Ref. to MECHANICAL\(H4DO\)>Crank Pulley>REMOVAL.](#)
 - [Ref. to MECHANICAL\(H4DO\)>Crank Pulley>INSTALLATION.](#)

MECHANICAL(H4DO) > Chain Cover

REMOVAL



Note:

When replacing a single part, perform the work with the engine assembly installed to body.

1. When working on the vehicle

Note:

When working on the vehicle, perform the following steps also.

(1) Drain engine coolant. Ref. to COOLING(H4DO)>Engine Coolant>REPLACEMENT > DRAINING OF ENGINE COOLANT.

(2) Perform the steps below to remove the air intake boot, and place it aside so that it does not interfere with the work.

Caution:

Do not remove the PCV hose No. 2 (a).

1) Remove the air cleaner case. Ref. to INTAKE (INDUCTION)(H4DO)>Air Cleaner Case>REMOVAL.

Note:

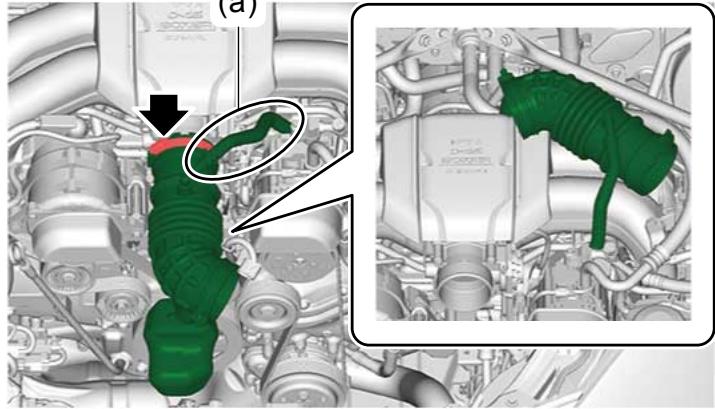
When removing/installing the chain cover, the chain cover may come in contact with the air cleaner case bracket. Therefore, the air cleaner case bracket must also be removed.

2) Loosen the clamp, remove the air intake boot, and place it aside so that it does not interfere with the work.

Caution:

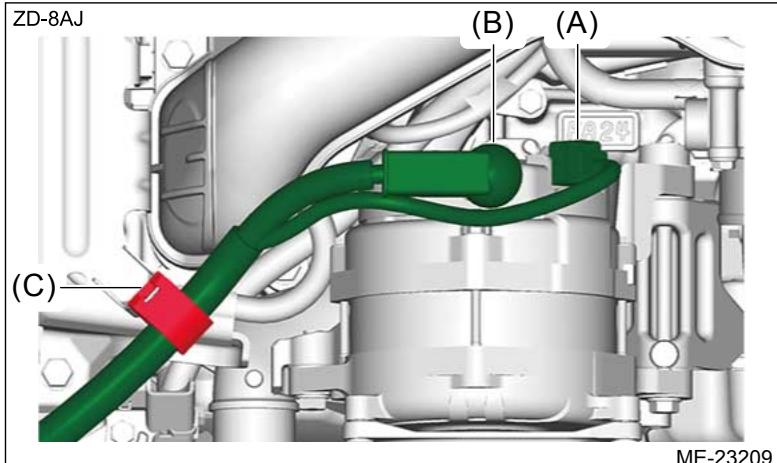
Be careful not to pull out the PCV hose No. 2 (a).

ZD-8AU



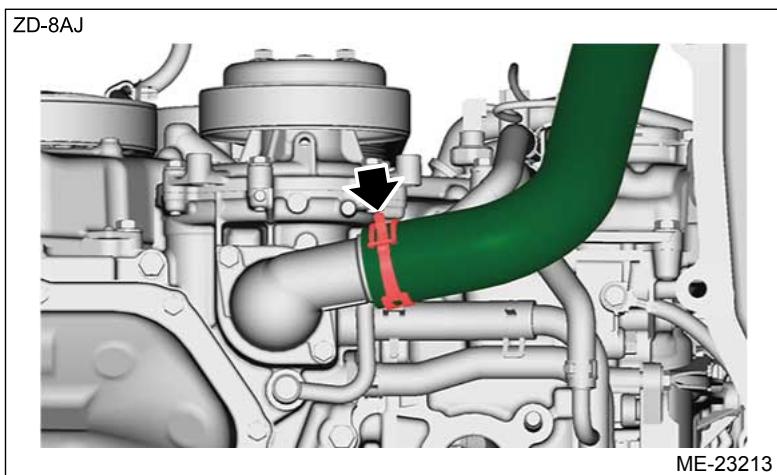
IN-10776

- (3) Remove the radiator inlet hose. Ref. to COOLING(H4DO)>Radiator Hose>REMOVAL > RADIATOR INLET HOSE.
- (4) Disconnect the connector (A) and terminal (B) from the generator.
- (5) Remove the clip (C) securing the generator cord to the fuel pipe protector RH No. 1, and place it aside so that it does not interfere with the work.



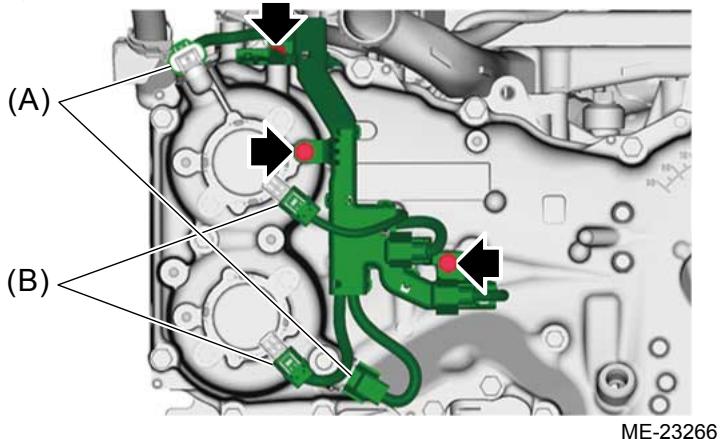
(6) Remove the front exhaust pipe. [Ref. to EXHAUST\(H4DO\)>Front Exhaust Pipe>REMOVAL.](#)

(7) Disconnect the radiator outlet hose from the engine unit.



- 2.** Drain the engine oil. [Ref. to LUBRICATION\(H4DO\)>Engine Oil>REPLACEMENT.](#)
- 3.** Remove the generator. [Ref. to STARTING/CHARGING SYSTEMS\(H4DO\)>Generator>REMOVAL.](#)
- 4.** Remove the A/C compressor. [Ref. to AIR CONDITIONER>Compressor>REMOVAL.](#)
- 5.** Remove the idler pulleys No. 2 and No. 3. [Ref. to MECHANICAL\(H4DO\)>V-belt>REMOVAL > IDLER PULLEY.](#)
- 6.** Remove the water pump pulley. [Ref. to COOLING\(H4DO\)>Water Pump>REMOVAL > WATER PUMP PULLEY.](#)
- 7.** Remove the crank pulley. [Ref. to MECHANICAL\(H4DO\)>Crank Pulley>REMOVAL.](#)
- 8.** Remove the engine oil cooler. [Ref. to LUBRICATION\(H4DO\)>Engine Oil Cooler>REMOVAL > ENGINE OIL COOLER.](#)
- 9.** Remove the engine oil cooler pipe. [Ref. to LUBRICATION\(H4DO\)>Engine Oil Cooler>REMOVAL > ENGINE OIL COOLER PIPE.](#)
- 10.** Remove the oil level gauge guide. [Ref. to LUBRICATION\(H4DO\)>Oil Level Gauge>REMOVAL.](#)
- 11.** Remove the fuel pipe protector RH No. 1. [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>Fuel Pipe Protector>REMOVAL>FUEL PIPE PROTECTOR RH >FUEL PIPE PROTECTOR RH NO. 1.](#)
- 12.** Remove the connector (A) and connector (B).
- 13.** Release the bolt securing the engine wiring harness, and place it aside so that it does not interfere with work.

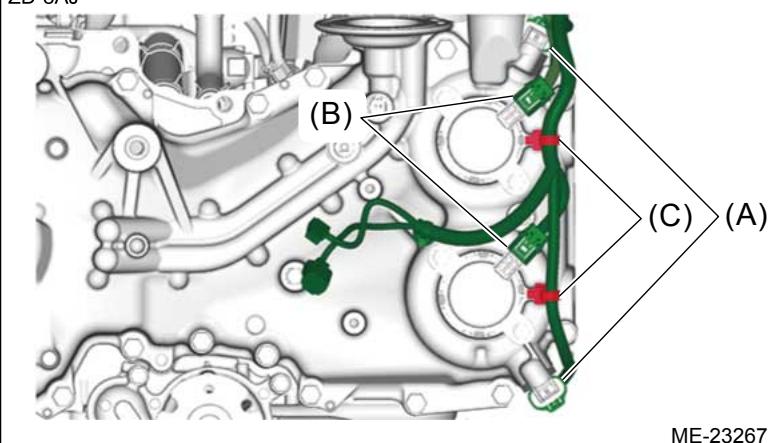
ZD-8AJ



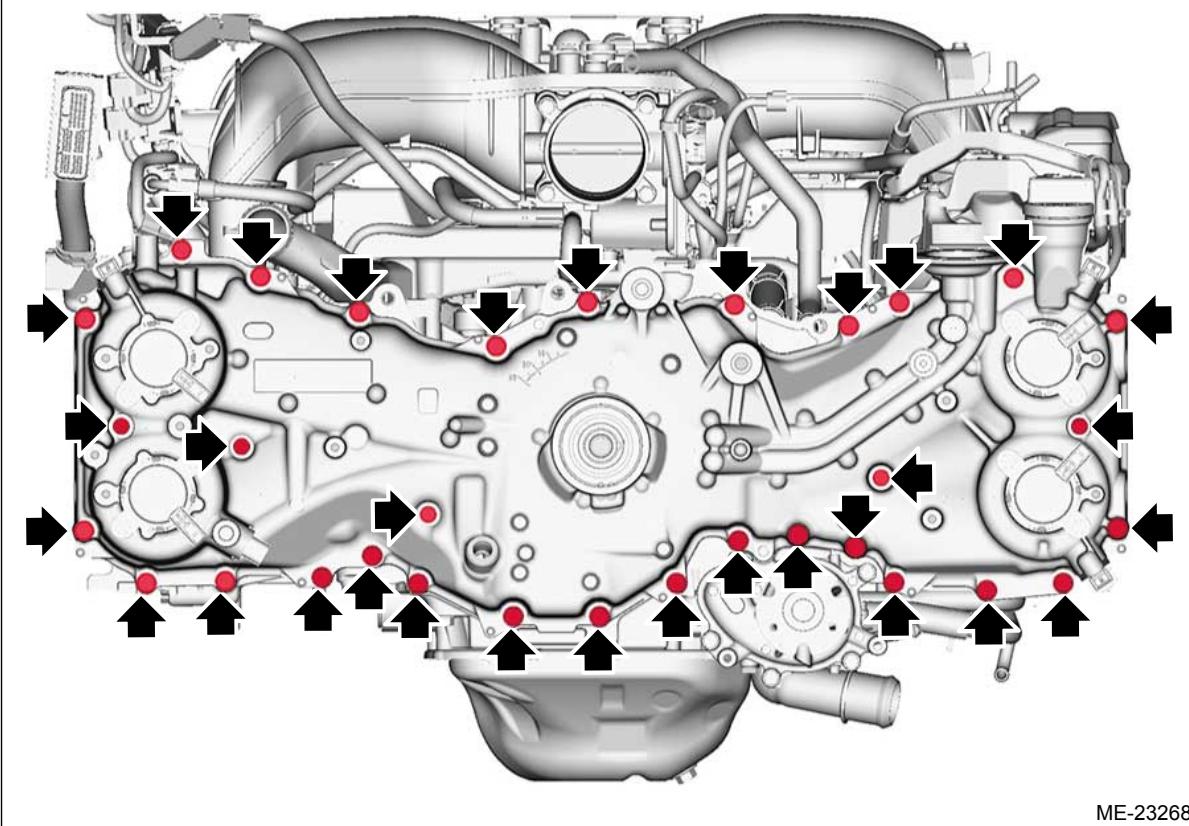
14. Remove the connector (A) and connector (B).

15. Remove the clip (C) securing the engine wiring harness, and place it aside so that it does not interfere with work.

ZD-8AJ



16. Remove the bolts securing the chain cover to the engine.



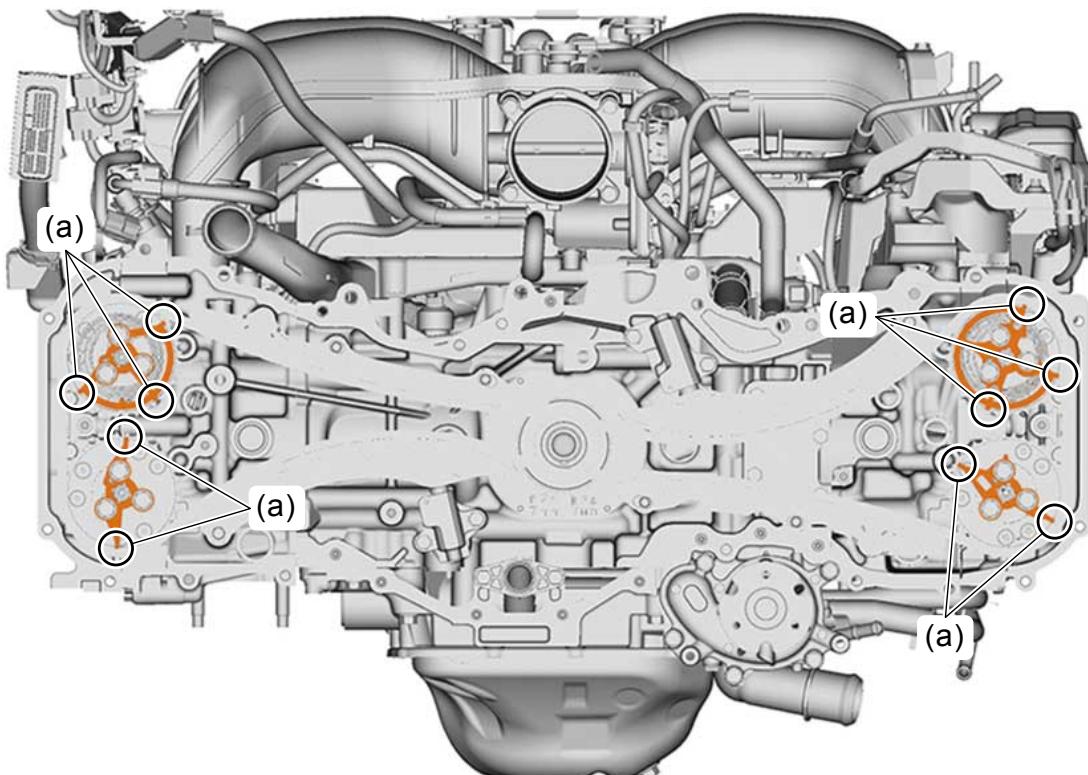
ME-23268

17. Expand the area shown in the figure using a crowbar or a similar tool wrapped in tape for protection, and remove the chain cover from the engine.

Caution:

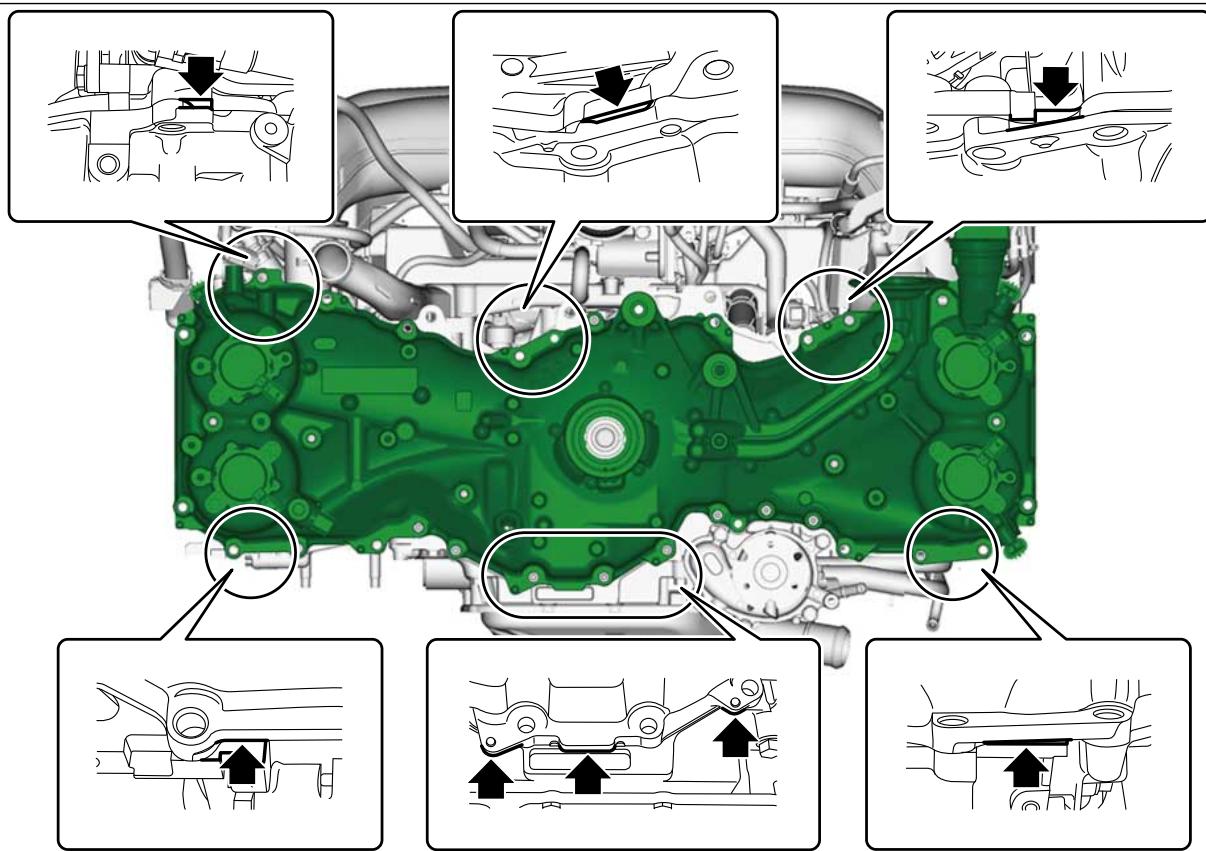
The chain cover may contact the protrusion (a) of cam sprocket sensor plate and cause damage. When removing the chain cover, move the chain cover horizontally until it cannot contact with the cam sprocket, and then remove it carefully.

ZD-8AJ



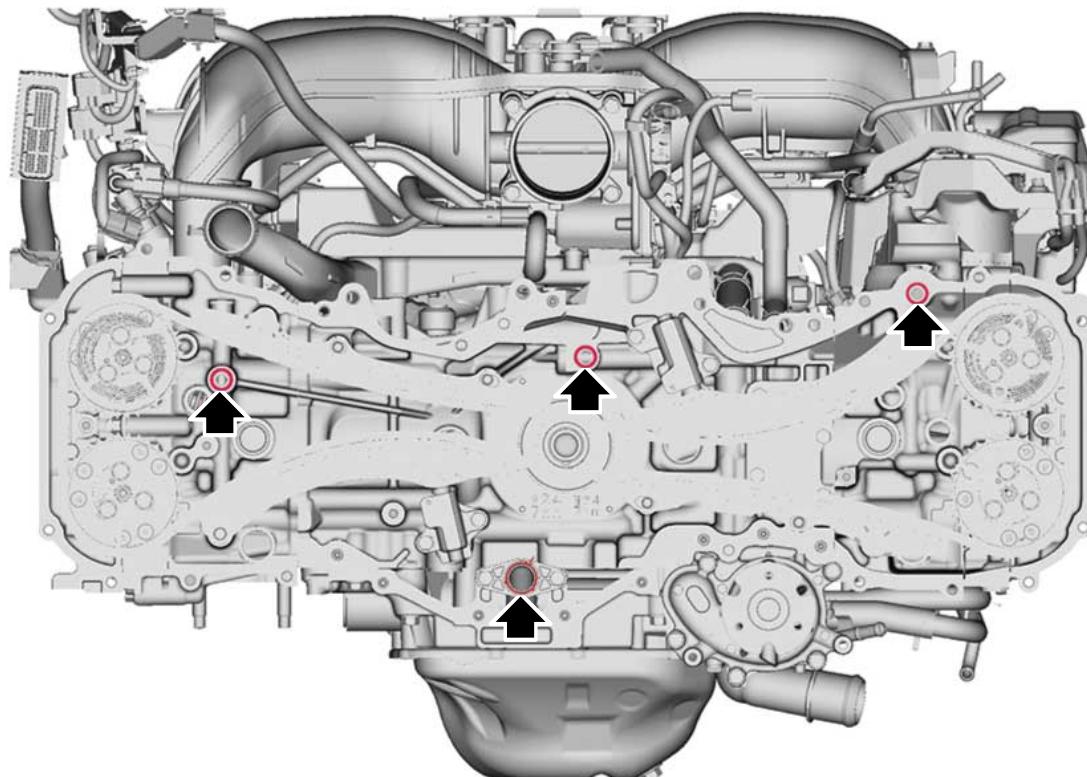
ME-23269

ZD-8AJ



ME-23270

18. Remove the O-rings from cylinder head RH, cylinder head LH, cylinder block LH and the oil strainer.



ME-23271

- 19.** Remove the liquid gasket from the chain cover and engine unit.

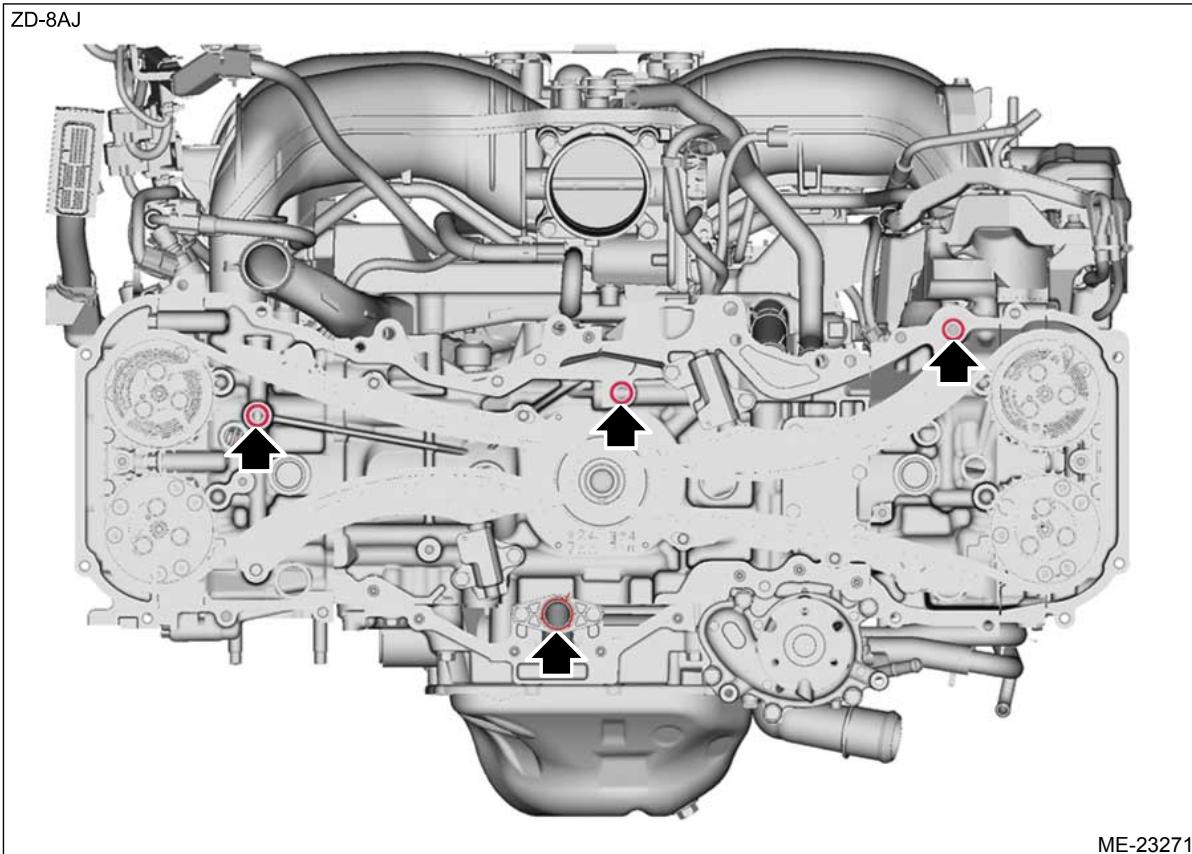
MECHANICAL(H4DO) > Chain Cover

INSTALLATION

- 1.** Install new O-rings to cylinder head RH, cylinder head LH, cylinder block LH and oil strainer.

Note:

Apply a coat of engine oil to the O-rings.

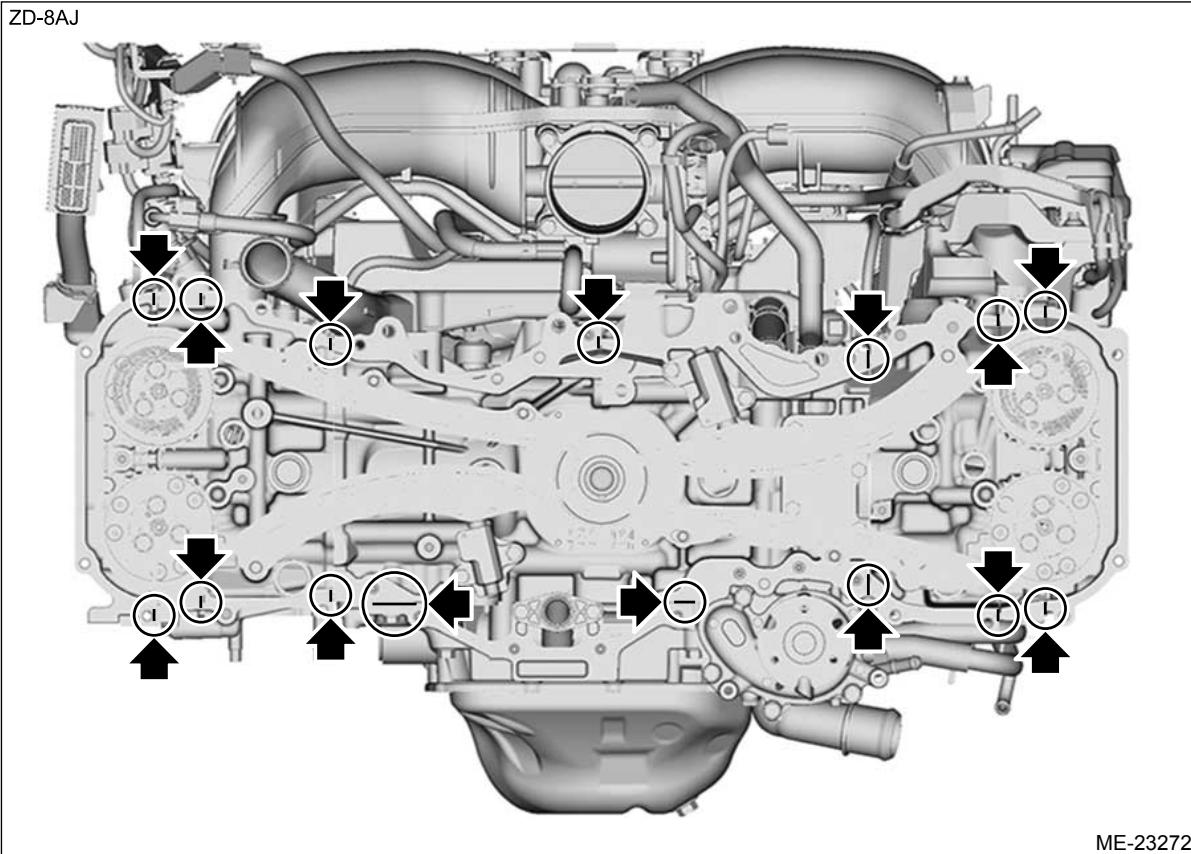


ME-23271

2. Apply liquid gasket if there is a dent at the positions as shown in the figure.

Preparation items:

Liquid gasket: THREE BOND 1217G (part No. K0877Y0100), THREE BOND 1217H or equivalent



ME-23272

3. Apply liquid gasket to the chain cover mating surface and center boss (5 places) as shown in the figure.

Note:

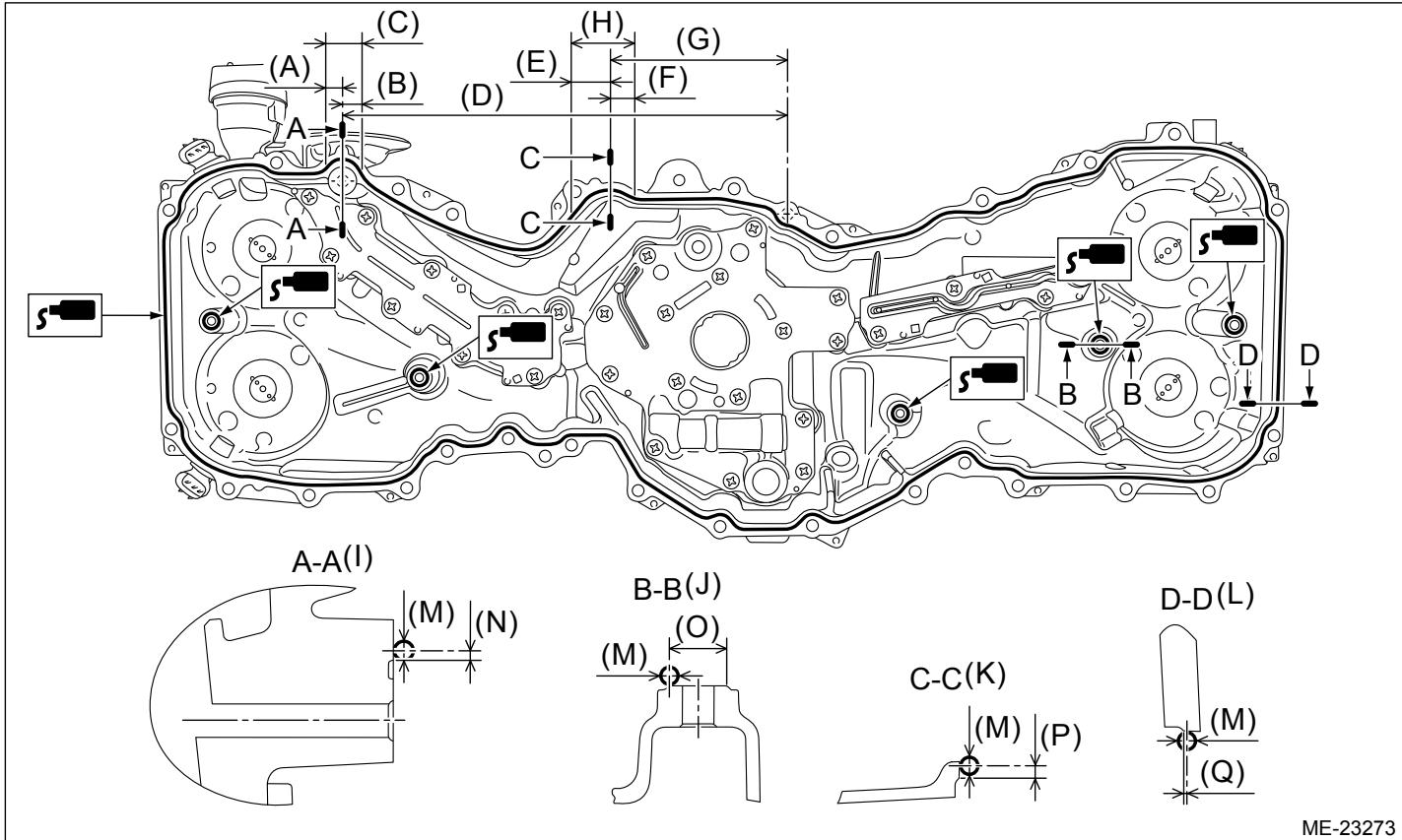
- Before applying liquid gasket, degrease the old liquid gasket seal surface of the engine and chain cover.
- Install within 5 min. after applying liquid gasket.

Preparation items:

Liquid gasket: THREE BOND 1217G (part No. K0877Y0100), THREE BOND 1217H or equivalent

Liquid gasket applying diameter:

4 ± 0.5 mm (0.1575±0.0197 in)



ME-23273

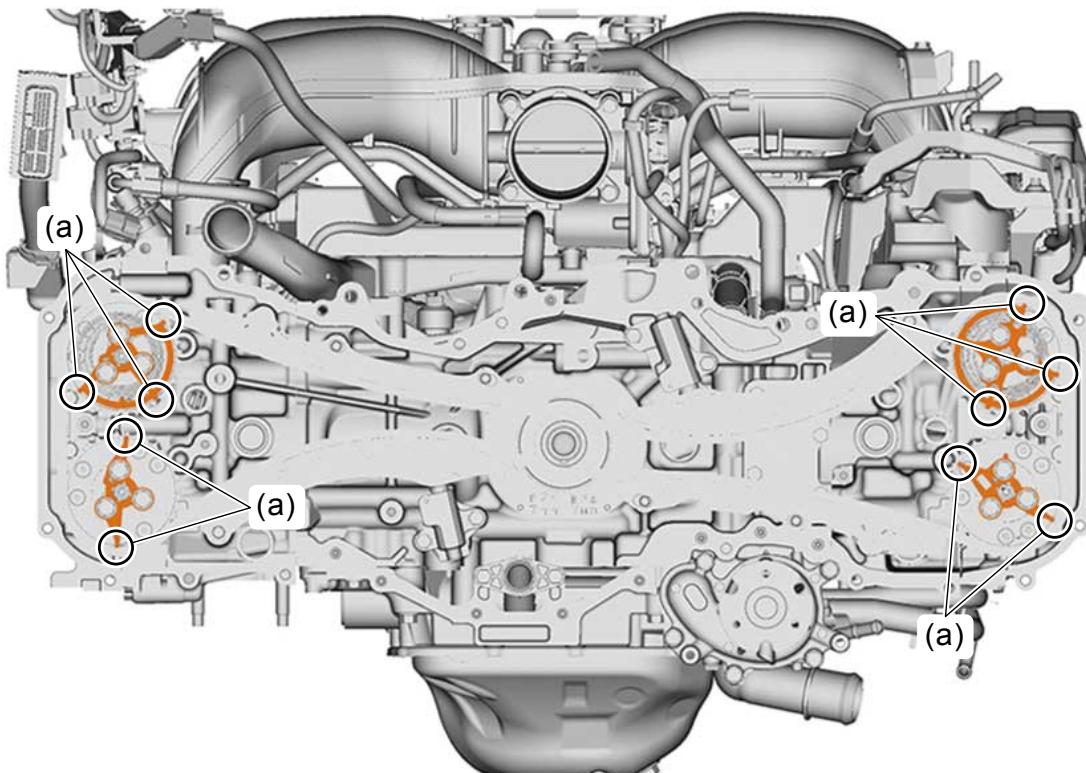
- | | | |
|---------------------------|---|--|
| (A) 14.5 mm (0.5709 in) | (G) 127 mm (5.0000 in) | (M) $\varnothing 4 \pm 0.5$ mm
$(0.1575 \pm 0.0197$ in) |
| (B) 17.5 mm (0.6890 in) | (H) Range B | (N) 2.3 mm (0.0906 in) |
| (C) Range A | (I) Liquid gasket applying position of mating surfaces of range A | (O) $\varnothing 12$ mm (0.4724 in) |
| (D) 316.2 mm (12.4488 in) | (J) Liquid gasket applying position of center boss (5 places) | (P) 2.8 mm (0.1102 in) |
| (E) 24.5 mm (0.9646 in) | (K) Liquid gasket applying position of mating surfaces of range B | (Q) 1 mm (0.0394 in) |
| (F) 18.5 mm (0.7283 in) | (L) Liquid gasket applying position of mating surfaces other than range A and range B | |

- 4.** Set the chain cover, and tighten the bolts in numerical order as shown in the figure.

Caution:

The chain cover may contact the protrusion (a) of cam sprocket sensor plate and cause damage. When setting the chain cover, move the chain cover horizontally and set it while taking care not to contact with the cam sprocket.

ZD-8AJ

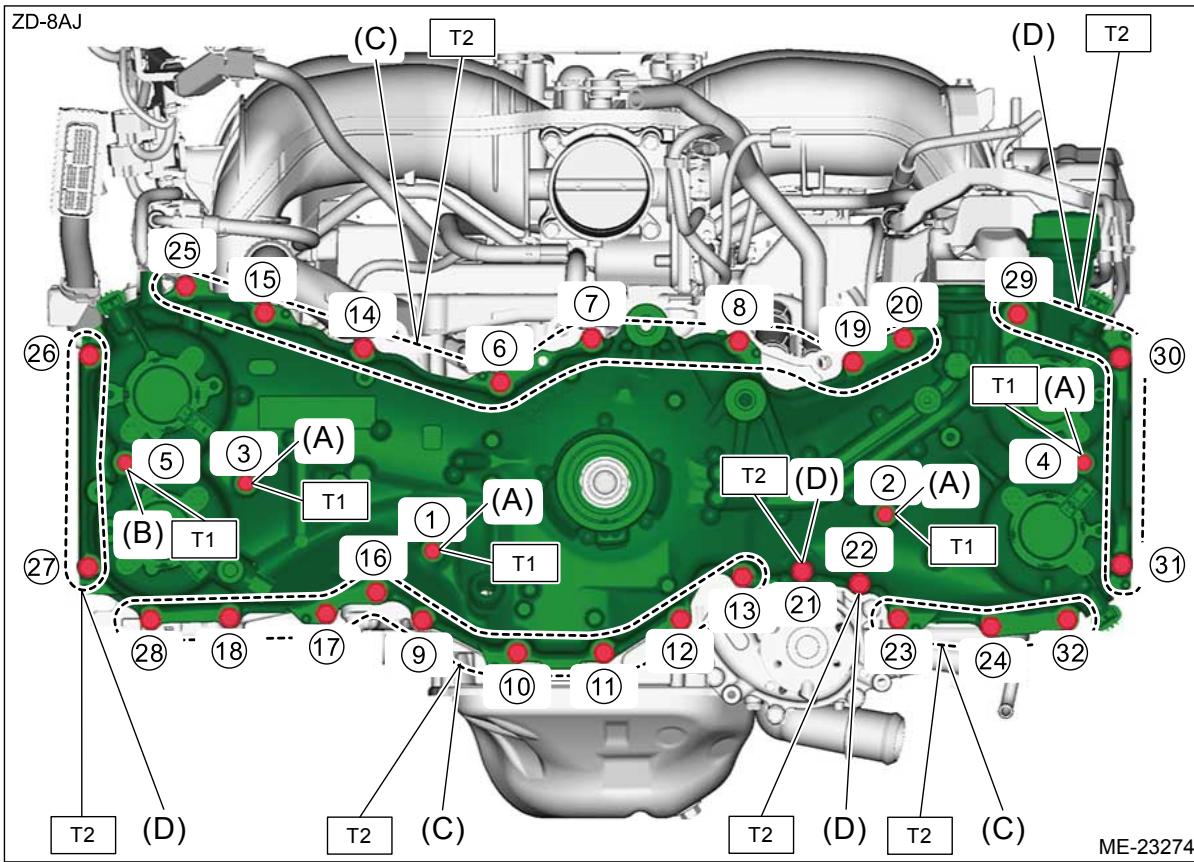


ME-23269

Tightening torque:

T1: 10 N·m (1.0 kgf-m, 7.4 ft-lb)

T2: 25 N·m (2.5 kgf-m, 18.4 ft-lb)



(A) M6 × 20

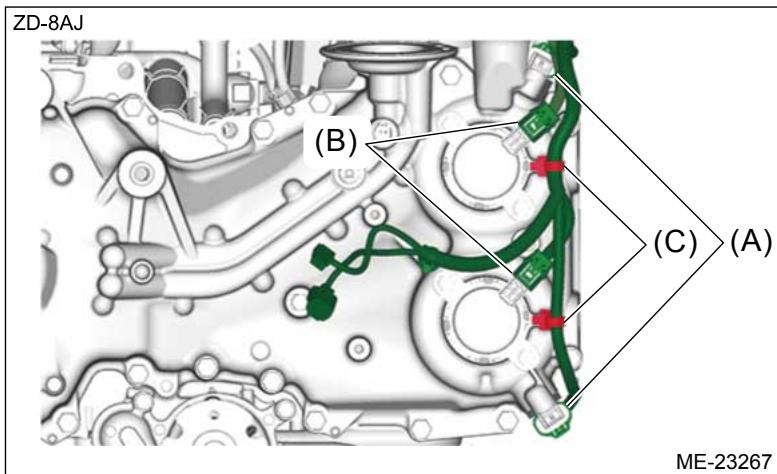
(C) M8 × 25

(D) M8 × 60

(B) M6 × 50

5. Place the engine wiring harness and secure the engine wiring harness with the clip (C).

6. Connect the connector (B) and connector (A).



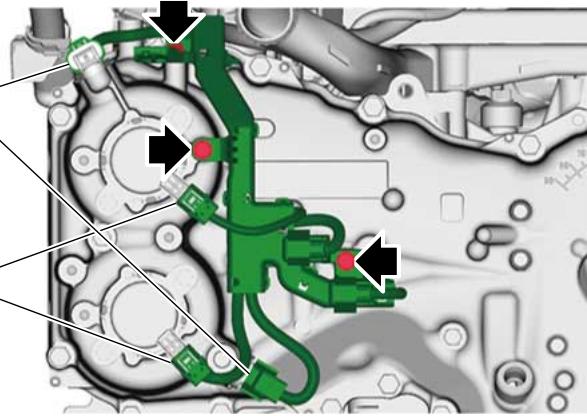
7. Place the engine wiring harness and secure the engine wiring harness with the bolt.

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

8. Connect the connector (A) and connector (B).

ZD-8AJ



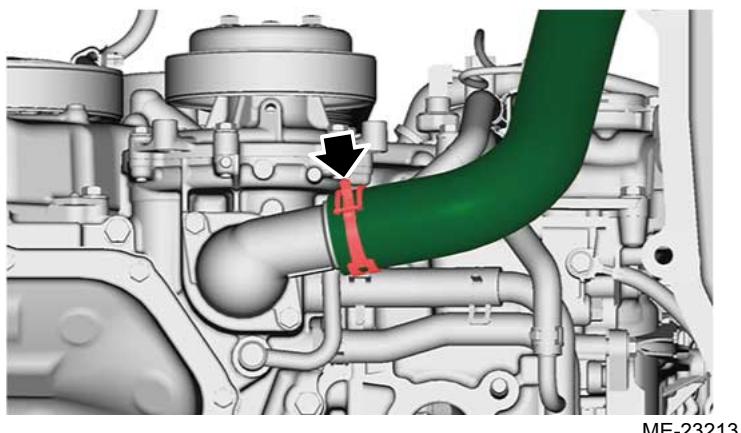
9. Install the fuel pipe protector RH No. 1. [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>Fuel Pipe Protector>INSTALLATION>FUEL PIPE PROTECTOR RH >FUEL PIPE PROTECTOR RH NO. 1.](#)
10. Install the oil level gauge guide. [Ref. to LUBRICATION\(H4DO\)>Oil Level Gauge>INSTALLATION.](#)
11. Install the engine oil cooler pipe. [Ref. to LUBRICATION\(H4DO\)>Engine Oil Cooler>INSTALLATION > ENGINE OIL COOLER PIPE.](#)
12. Attach the engine oil cooler. [Ref. to LUBRICATION\(H4DO\)>Engine Oil Cooler>INSTALLATION > ENGINE OIL COOLER.](#)
13. Install the crank pulley. [Ref. to MECHANICAL\(H4DO\)>Crank Pulley>INSTALLATION.](#)
14. Install the water pump pulley. [Ref. to COOLING\(H4DO\)>Water Pump>INSTALLATION > WATER PUMP PULLEY.](#)
15. Install the idler pulleys No. 2 and No. 3. [Ref. to MECHANICAL\(H4DO\)>V-belt>INSTALLATION > IDLER PULLEY.](#)
16. Install the A/C compressor. [Ref. to AIR CONDITIONER>Compressor>INSTALLATION.](#)
17. Install the generator. [Ref. to STARTING/CHARGING SYSTEMS\(H4DO\)>Generator>INSTALLATION.](#)
18. Fill engine oil. [Ref. to LUBRICATION\(H4DO\)>Engine Oil>REPLACEMENT.](#)
19. When working on the vehicle

Note:

When working on the vehicle, perform the following steps also.

- (1) Connect the radiator outlet hose to the engine unit.

ZD-8AJ



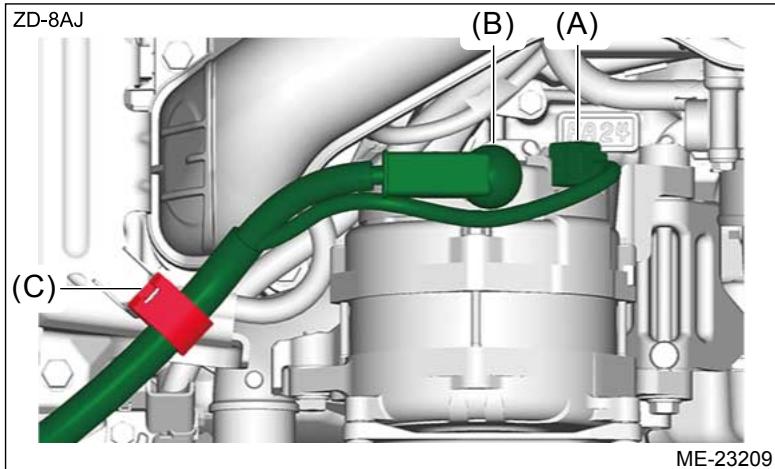
- (2) Install the front exhaust pipe. [Ref. to EXHAUST\(H4DO\)>Front Exhaust Pipe>INSTALLATION.](#)
- (3) Set the generator cord, and secure the generator cord to the fuel pipe protector RH No. 1 using clip

(C).

(4) Connect the connector (A) and terminal (B) to the generator.

Tightening torque:

15.5 N·m (1.6 kgf-m, 11.4 ft-lb)



(5) Attach the radiator inlet hose. [Ref. to COOLING\(H4DO\)>Radiator Hose>INSTALLATION > RADIATOR INLET HOSE.](#)

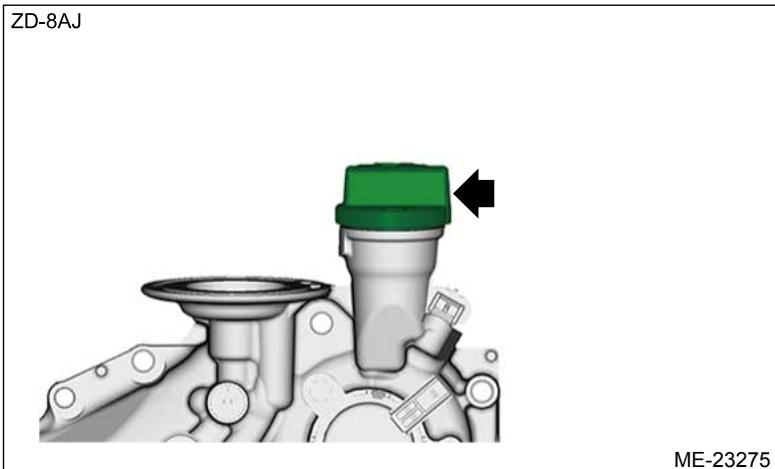
(6) Install the air intake boot. [Ref. to INTAKE \(INDUCTION\)\(H4DO\)>Air Intake Boot>INSTALLATION.](#)

(7) Fill engine coolant. [Ref. to COOLING\(H4DO\)>Engine Coolant>REPLACEMENT > FILLING OF ENGINE COOLANT.](#)

MECHANICAL(H4DO) > Chain Cover

DISASSEMBLY

1. Remove the oil filler cap.



2. Remove the oil pressure switch. [Ref. to LUBRICATION\(H4DO\)>Oil Pressure Switch>REMOVAL.](#)
3. Remove the engine oil temperature sensor. [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>Engine Oil Temperature Sensor>REMOVAL.](#)
4. Remove the oil control solenoid. [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>Oil Control Solenoid>REMOVAL.](#)
5. Remove the camshaft position sensor. [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>Camshaft Position Sensor>REMOVAL.](#)

MECHANICAL(H4DO) > Chain Cover

ASSEMBLY

1. Install the camshaft position sensor.  [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>Camshaft Position Sensor>INSTALLATION.](#)
2. Install the oil control solenoid.  [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>Oil Control Solenoid>INSTALLATION.](#)
3. Install the engine oil temperature sensor.  [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>Engine Oil Temperature Sensor>INSTALLATION.](#)
4. Install the oil pressure switch.  [Ref. to LUBRICATION\(H4DO\)>Oil Pressure Switch>INSTALLATION.](#)
5. Install the oil filler cap.

MECHANICAL(H4DO) > Chain Cover

INSPECTION

Check that the chain cover does not have deformation, cracks and any other damage.

MECHANICAL(H4DO) > Timing Chain Assembly

REMOVAL



1. TIMING CHAIN RH

Note:

When replacing a single part, perform the work with the engine assembly installed to body.

1. Remove the chain cover. [Ref. to MECHANICAL\(H4DO\)>Chain Cover>REMOVAL.](#)
2. Using the ST and by turning the crankshaft, align the alignment mark of crank sprocket, the alignment mark (protrusion) of the intake cam sprocket RH and the alignment mark (Δ mark) of the exhaust cam sprocket RH to the positions as shown in the figure.

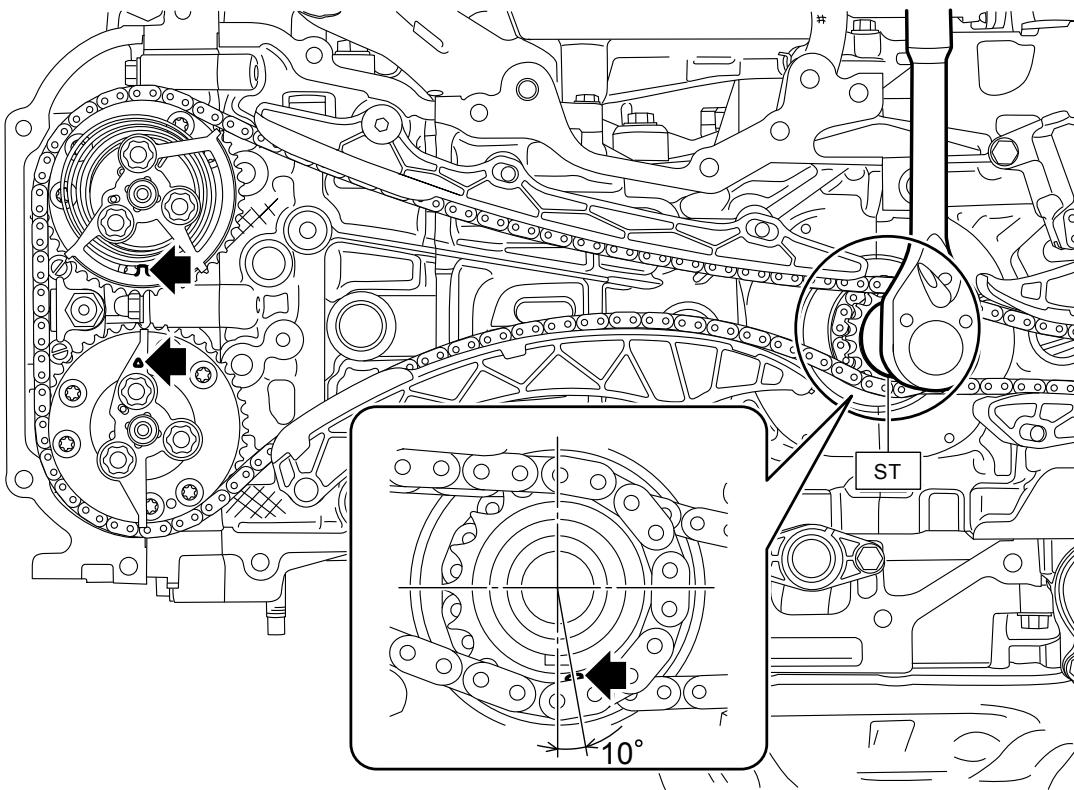
Note:

If the alignment marks are aligned to the positions as shown in the figure, the crankshaft key is located at six o'clock position.

Preparation tool:

ST: CRANKSHAFT SOCKET (18252AA000)

ZD-8AJ



ME-23276

3. When the cam sprocket RH is removed, and the cam carrier RH is disassembled

Note:

Follow also steps below when the cam sprocket RH is removed, and the cam carrier RH is disassembled.

- (1) Using the ST, loosen the bolts which hold the cam sprocket RH.

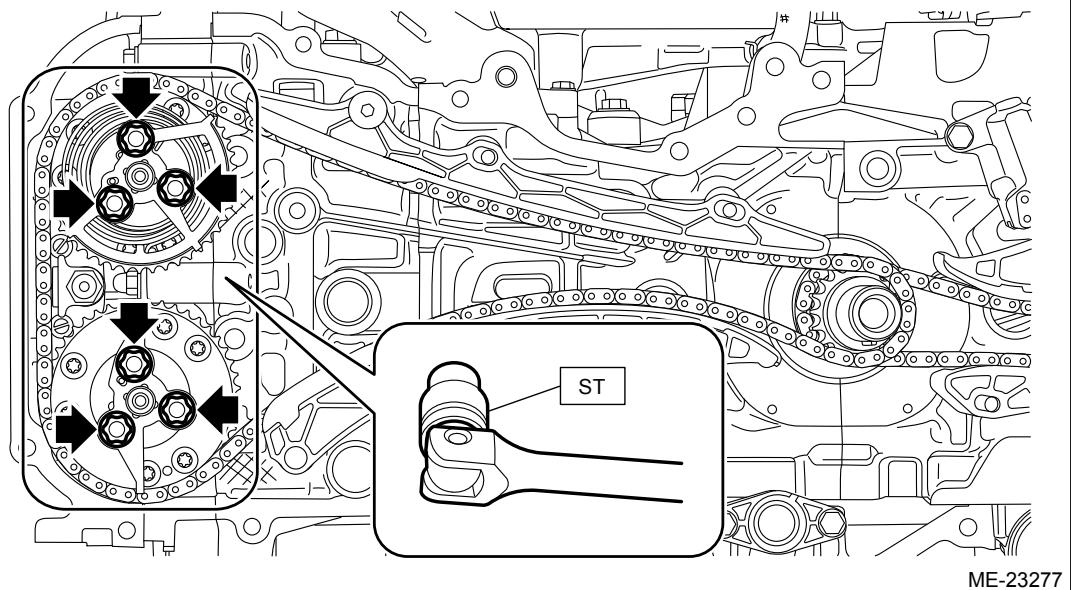
Caution:

In order to prevent damage on each component, be careful not to loosen the bolts too much.

Preparation tool:

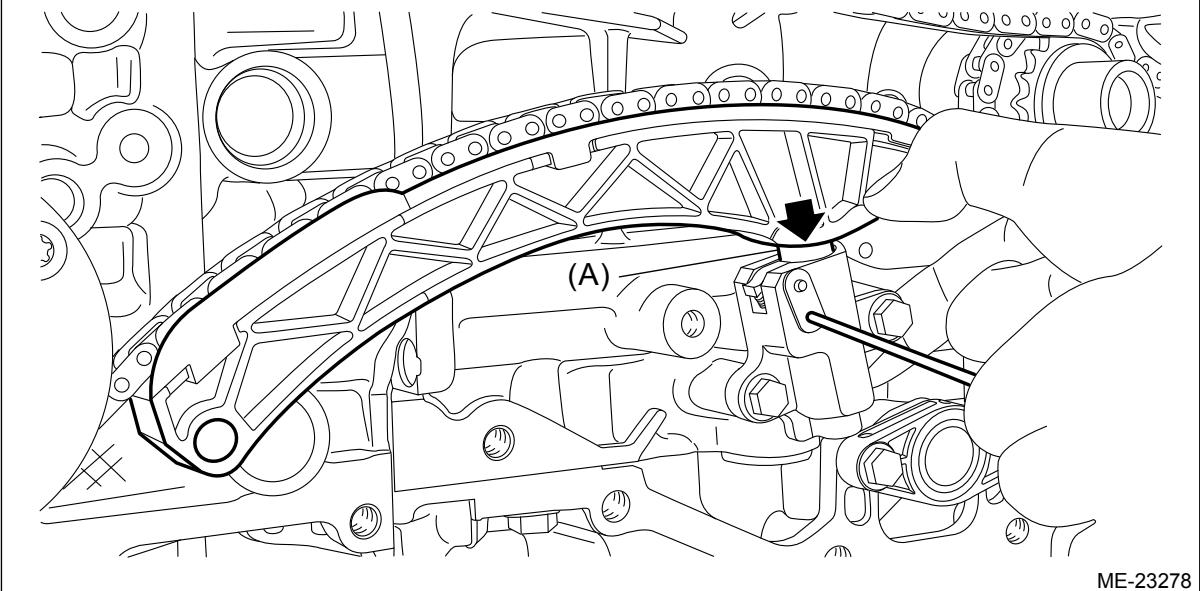
ST: SOCKET (E16) (18270KA010)

ZD-8AJ

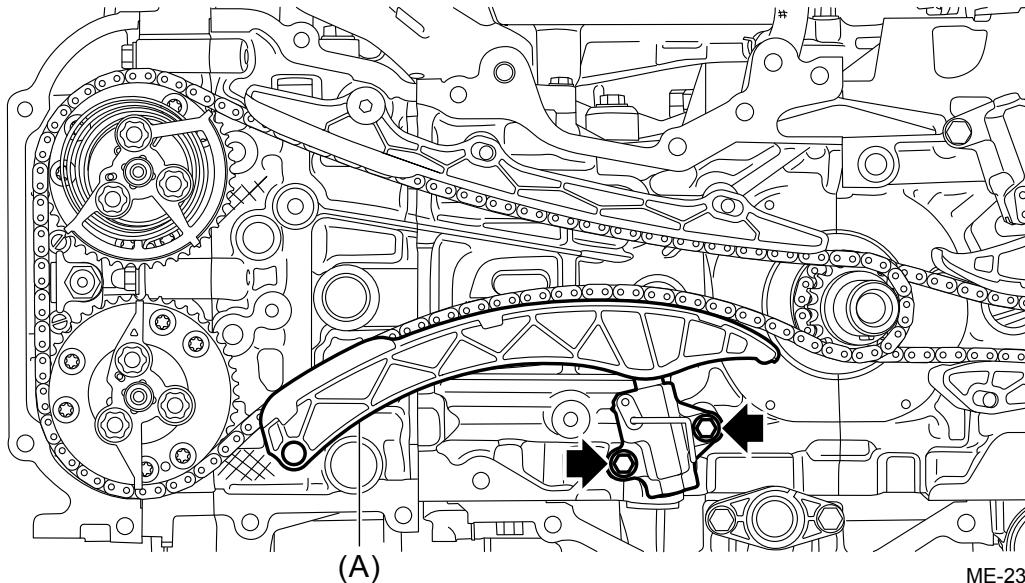


- 4.** Push down the chain tensioner lever RH as shown in the figure, and insert a 2.5 mm (0.0984 in) dia. stopper pin or a 2.5 mm dia. hex wrench into the stopper pin hole in the chain tensioner RH to secure the plunger (A).

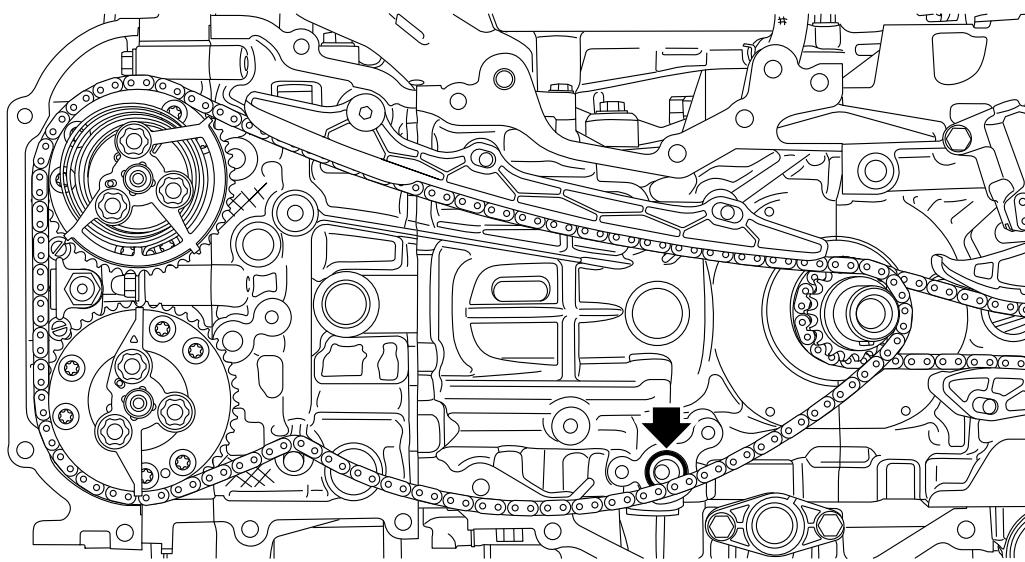
ZD-8AJ



- 5.** Remove the chain tensioner RH, and remove the chain tensioner lever RH (A).



6. Remove the O-ring from the cylinder block RH.



7. Remove the chain guide RH, and remove the timing chain RH (A).

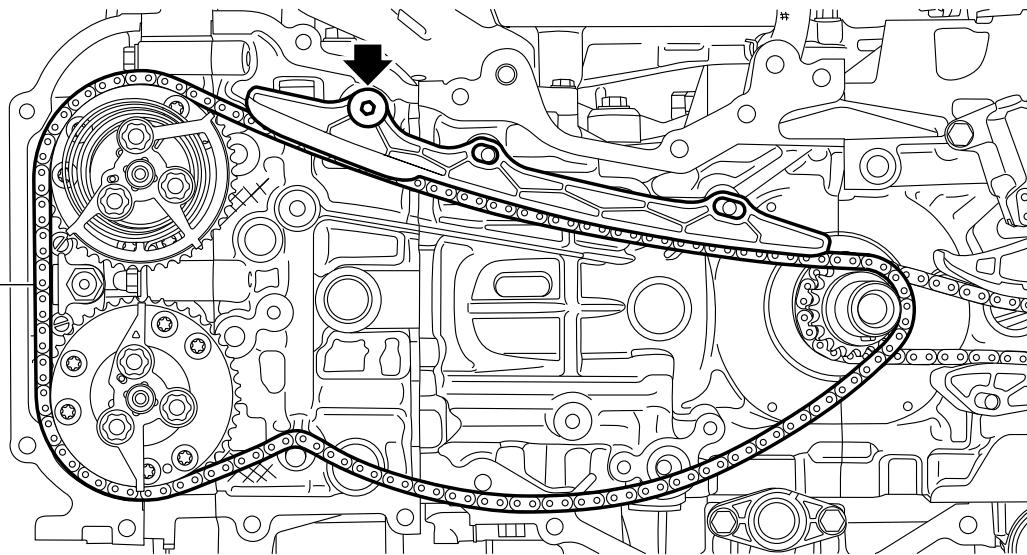
Caution:

- If the timing chain RH is not installed, the intake camshaft RH and exhaust camshaft RH are kept at zero-lift position. All cams on the camshaft are not pressing down the roller rocker arm (intake valve and exhaust valve). (Under this condition, all valves remain unlifted.)
- Intake camshaft RH and exhaust camshaft RH can be independently rotated with the timing chain RH removed. When the intake valve and exhaust valve lift at the same time, the valve heads contact each other and valve stem may bend. Do not turn it to the outside of range of zero-lift (in range where it can be turned lightly by hand).

Note:

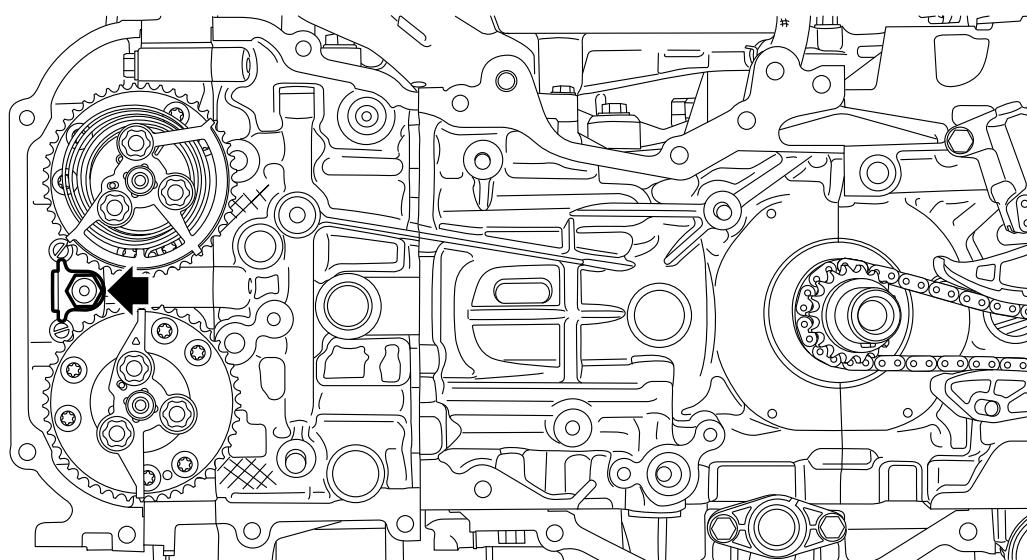
To avoid mixing with LH side, keep the removed part in order.

ZD-8AJ



8. Remove the side chain guide RH from the front camshaft cap RH.

ZD-8AJ

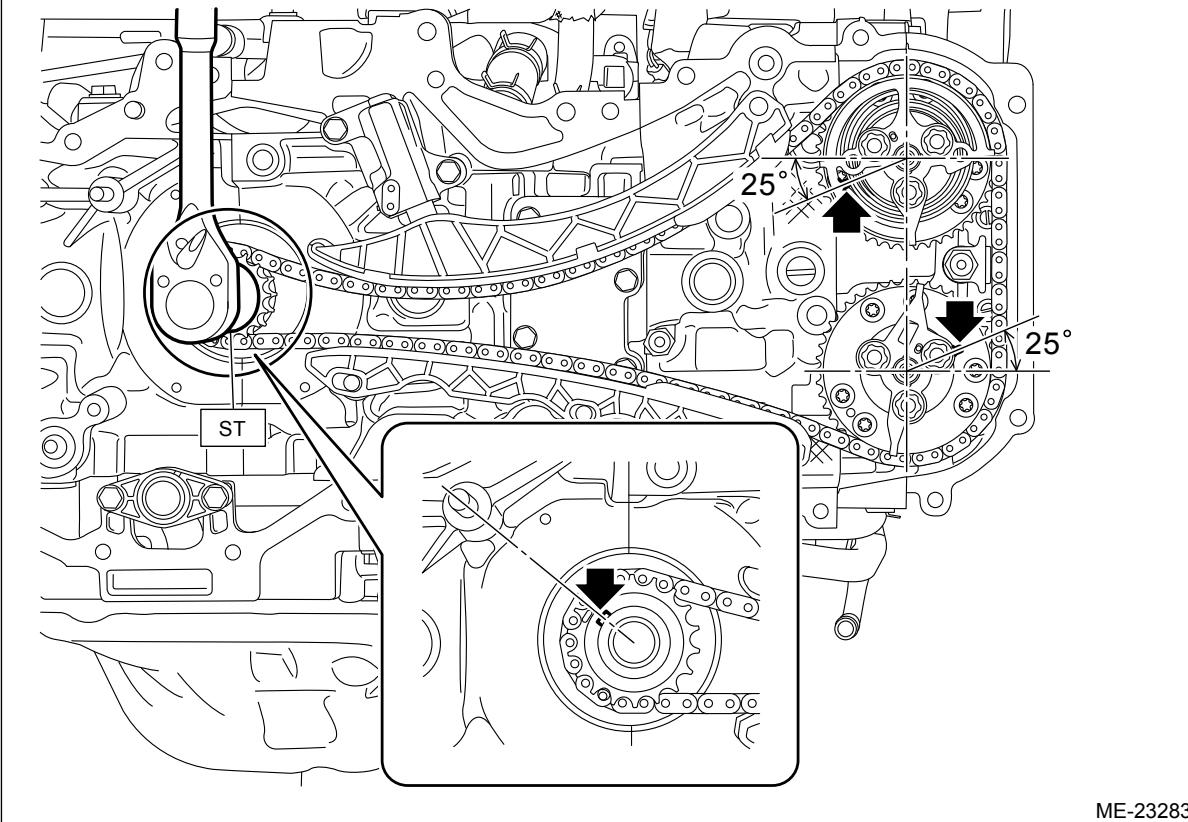


2. TIMING CHAIN LH

1. Remove the timing chain RH.  Ref. to MECHANICAL(H4DO)>Timing Chain Assembly>REMOVAL > [TIMING CHAIN RH](#).
2. Using the ST and by turning the crankshaft, align the key of the crankshaft, the alignment mark (protrusion) of the intake cam sprocket LH and the alignment mark (protrusion) of the exhaust cam sprocket LH to the positions as shown in the figure.

Preparation tool:

ST: CRANKSHAFT SOCKET (18252AA000)



ME-23283

3. When the cam sprocket LH is removed, and the cam carrier LH is disassembled

Note:

Follow also steps below when the cam sprocket LH is removed, and the cam carrier LH is disassembled.

- (1) Using the ST, loosen the bolts which hold the cam sprocket LH.

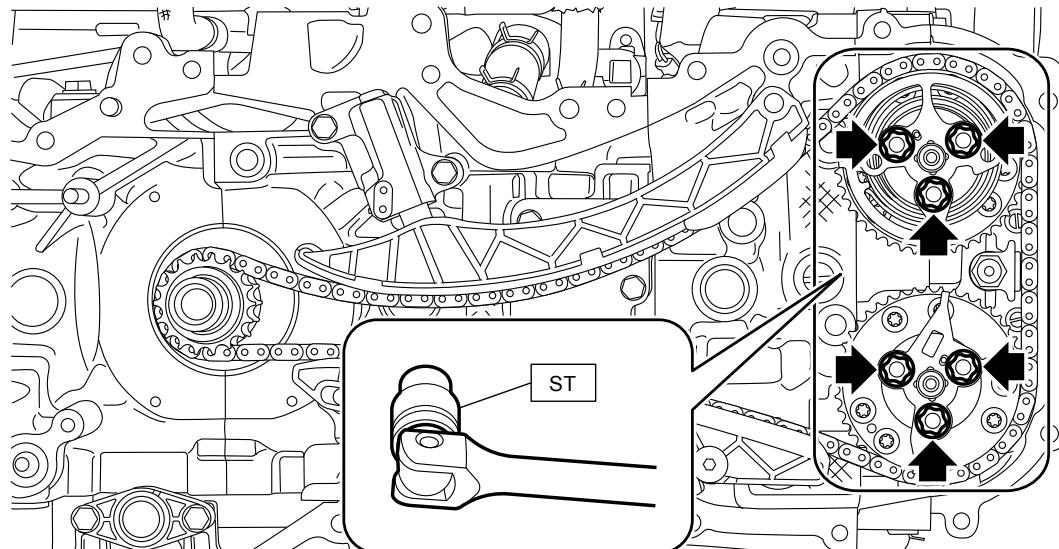
Caution:

In order to prevent damage on each component, be careful not to loosen the bolts too much.

Preparation tool:

ST: SOCKET (E16) (18270KA010)

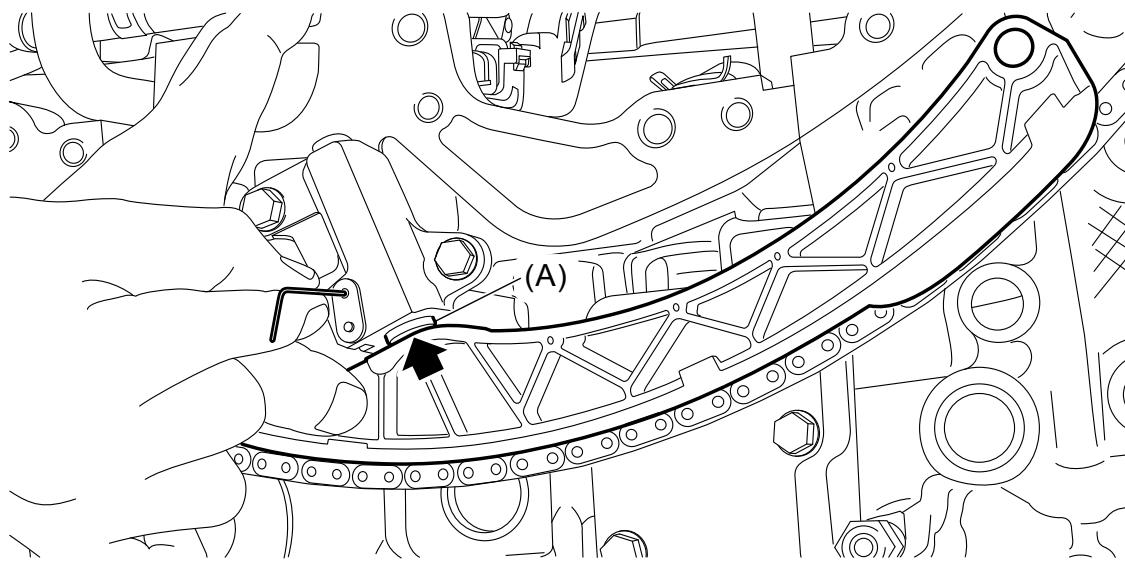
ZD-8AJ



ME-23284

4. Push up the chain tensioner lever LH as shown in the figure, and insert a stopper pin (clips, etc.) with a diameter of 1.2 mm (0.0472 in) or less or a hex wrench with a diameter of 1.2 mm into the stopper pin hole in the chain tensioner LH to secure the plunger (A).

ZD-8AJ

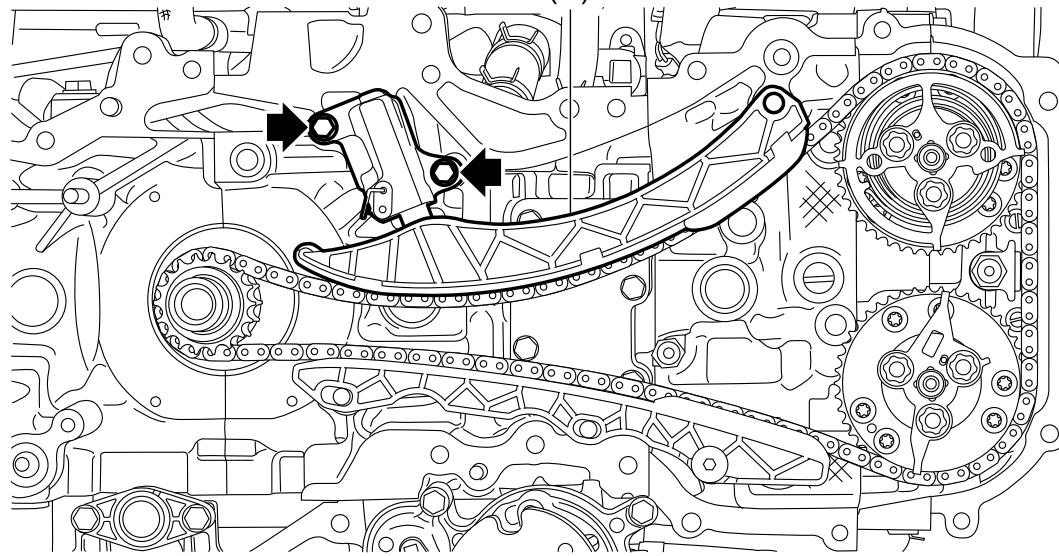


ME-23285

5. Remove the chain tensioner LH, and remove the chain tensioner lever LH (A).

ZD-8AJ

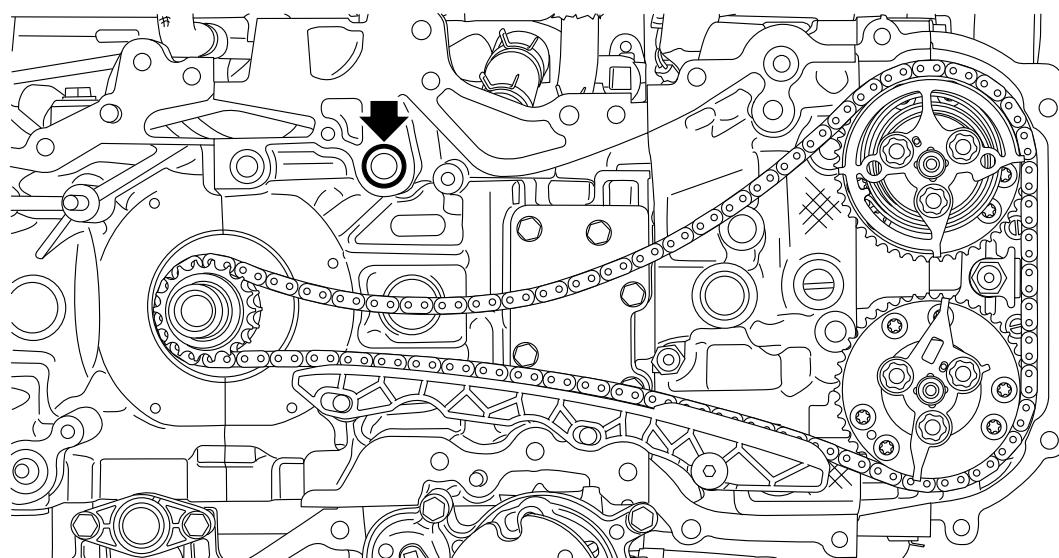
(A)



ME-23286

6. Remove the O-ring from the cylinder block LH.

ZD-8AJ



ME-23287

7. Remove the chain guide LH, and remove the timing chain LH (A).

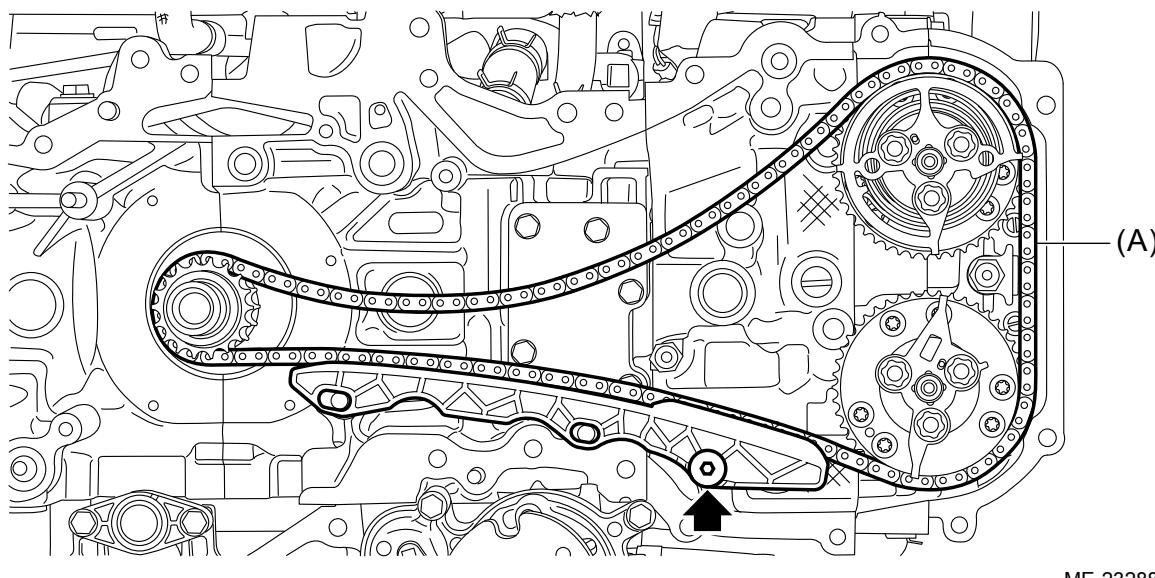
Caution:

- If the timing chain LH is not installed, the exhaust camshaft LH is kept at zero-lift position. All cams on the exhaust camshaft LH are not pressing down the roller rocker arm (exhaust valve). (Under this condition, exhaust valves remain unlifted.)
- Intake camshaft LH is kept at lift position. All cams on the intake camshaft LH are pressing down the roller rocker arm (intake valve). (Under this condition, intake valves remain lifted.)
- Intake camshaft LH and exhaust camshaft RH can be independently rotated with the timing chain LH removed. When the exhaust camshaft LH is turned, the valve heads contact each other and valve stem may bend as described in above. Do not turn the exhaust camshaft LH to the outside of range of zero-lift (in range where it can be turned lightly by hand).
- The #4 piston is located near TDC. If the intake camshaft LH is turned, the valve and the piston may contact and valve stem may bend. Do not turn the intake camshaft LH at this time.

Note:

To avoid mixing with RH side, keep the removed part in order.

ZD-8AJ



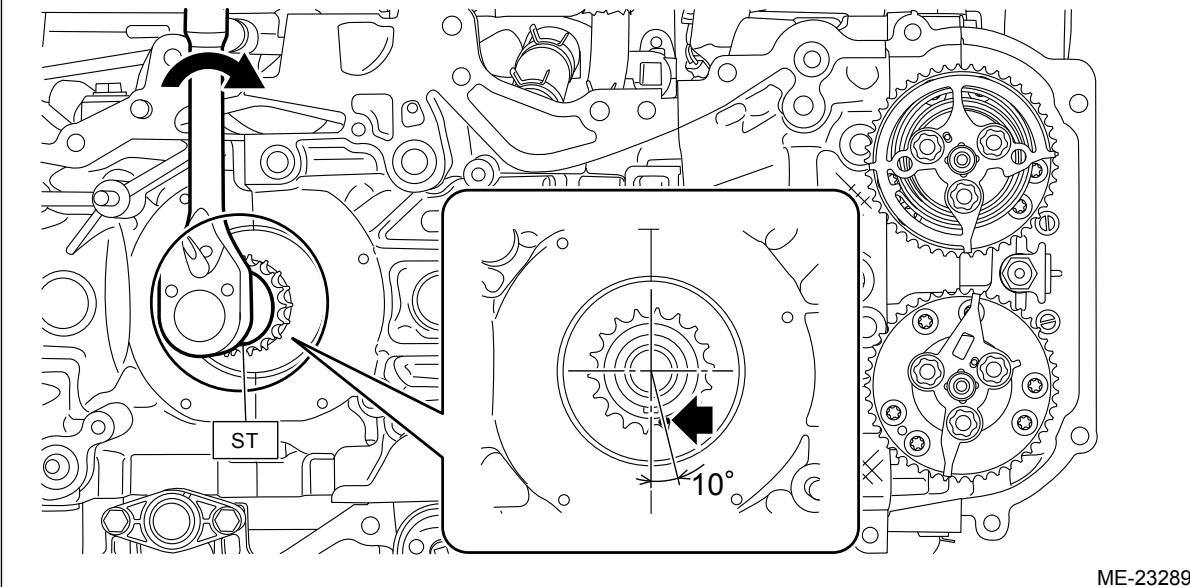
8. Using the ST and by turning the crankshaft approximately 200° clockwise, align the alignment marks of crank sprocket to the positions as shown in the figure.

Caution:

- This procedure is required to prevent the valve and piston contacting with each other, by moving the all pistons to the middle of the cylinders.
- Never turn counterclockwise because the valve and piston may contact. Counterclockwise turn is allowed only when adjusting precisely the alignment marks, after turning the crank sprocket alignment mark clockwise near the position as shown in the figure.

Preparation tool:

ST: CRANKSHAFT SOCKET (18252AA000)



- 9.** Using ST1 and ST2 by turning the intake cam sprocket LH approximately 210° clockwise, align the alignment marks (protrusion) of intake cam sprocket LH to the positions (zero-lift position) as shown in the figure.

Caution:

- After this work, when the intake valve and exhaust valve lift at the same time, the valve heads contact each other and valve stem may bend. Do not turn the intake camshaft LH and exhaust camshaft LH to the outside of range of zero-lift (in range where it can be turned lightly by hand).
- Perform the operation carefully since the ST comes off easily.

Note:

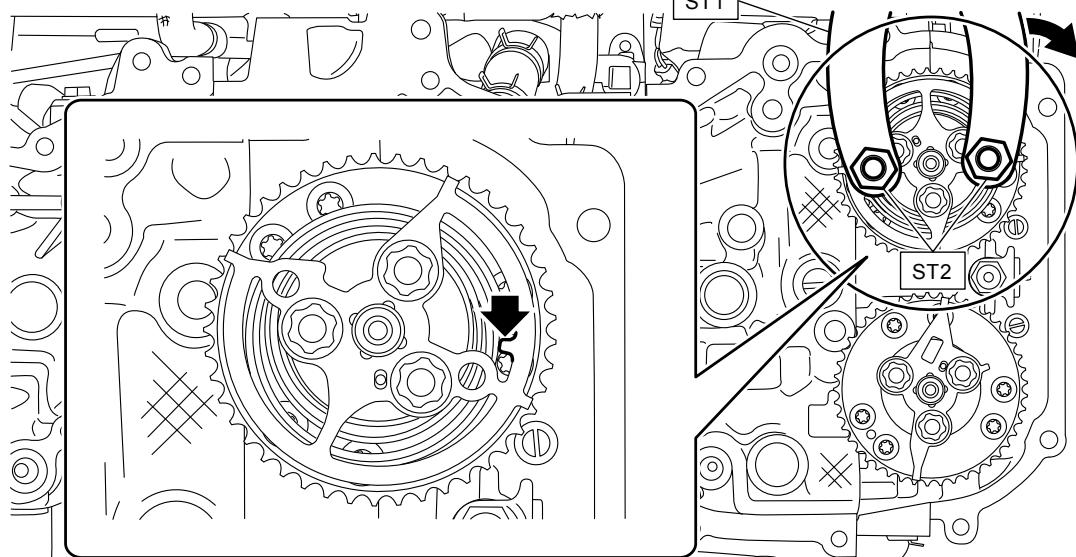
Intake camshaft LH has four peaks of drive sections for the high-pressure fuel pump.
Therefore, there is little range where it can be turned lightly by hand in zero-lift position.

Preparation tool:

ST1: PULLEY WRENCH (18355AA000)

ST2: PULLEY WRENCH PIN SET (18334AA020)

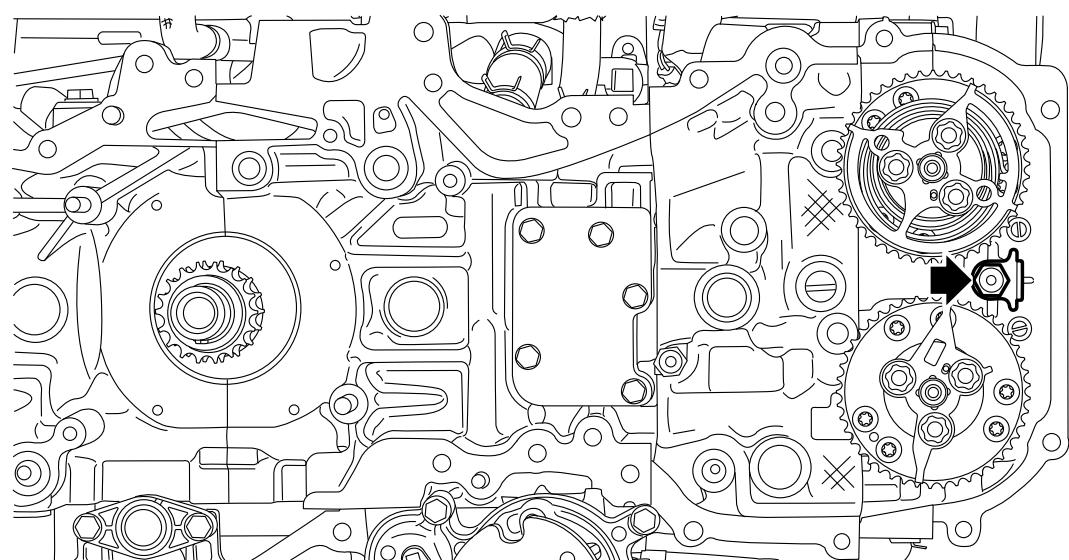
ZD-8AJ



ME-23290

10. Remove the side chain guide LH from the front camshaft cap LH.

ZD-8AJ



ME-23291

INSTALLATION

1. TIMING CHAIN LH

Note:

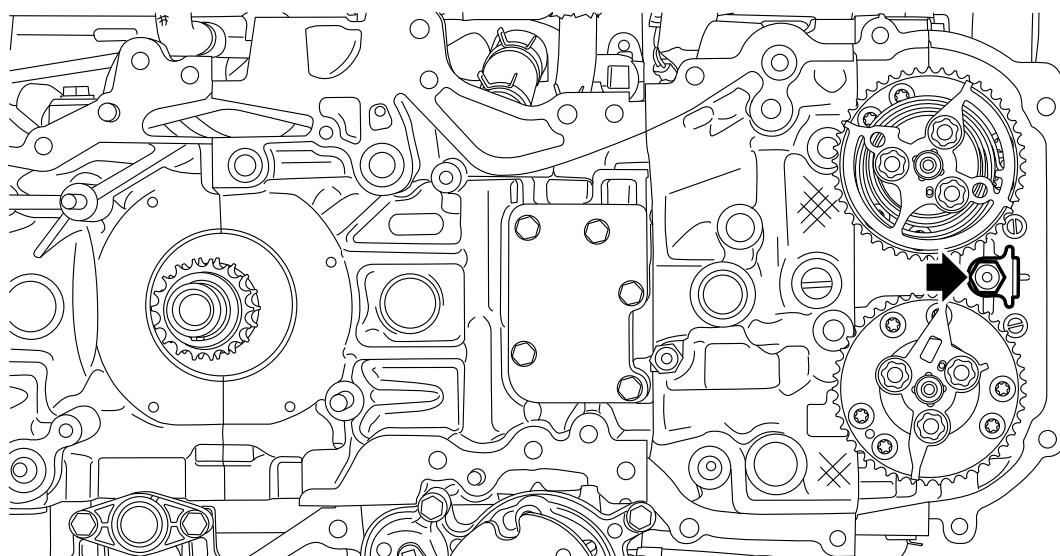
- Be careful that the foreign matter is not into or onto the assembled component during installation.
- Apply engine oil to all component parts of the timing chain.

1. Install the side chain guide LH to the front camshaft cap LH.

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

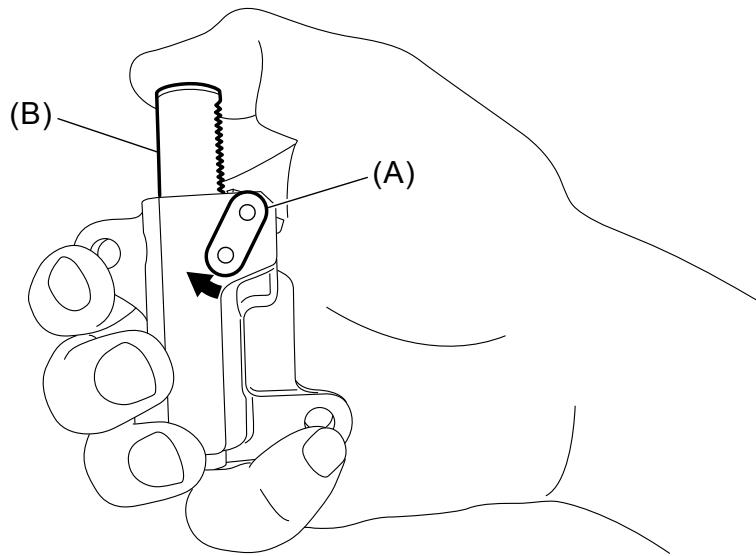
ZD-8AJ



ME-23291

2. Prepare to attach the chain tensioner LH.

(1) Press the link plate (A) in the direction of arrow to insert the plunger (B).

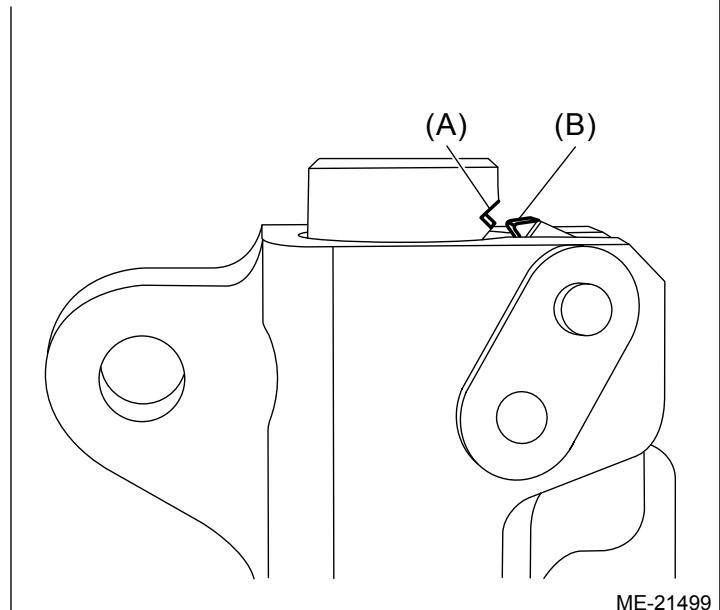
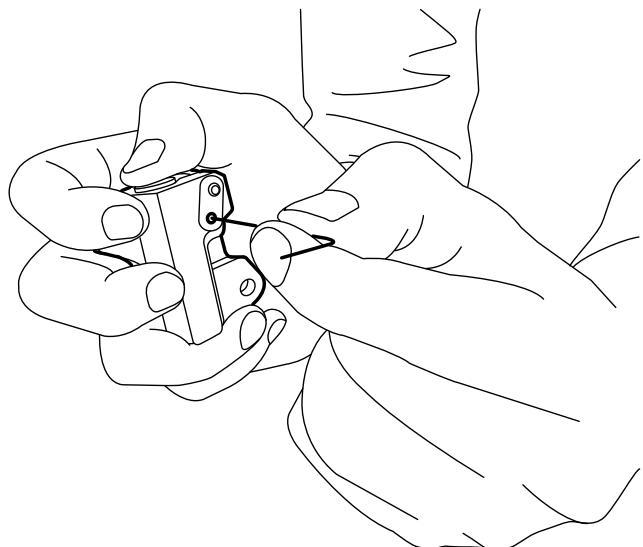


ME-23292

- (2) In order to secure the plunger, insert a stopper pin (clips, etc.) with a diameter of 1.2 mm (0.0472 in) or less or a hex wrench with a diameter of 1.2 mm into the stopper pin hole.

Note:

If the stopper pin hole on the link plate and the stopper pin hole on the chain tensioner are not aligned, check that the first notch of plunger rack (A) is engaged with the stopper tooth (B). If not engaged, retract the plunger a little so that the first notch of plunger rack (A) is engaged with the stopper tooth (B).



ME-21499

- 3.** Check that the alignment mark of the crank sprocket is located at the position shown in the figure. If not aligned, using the ST turn the crankshaft to align the crank sprocket alignment mark to the position shown in the figure.

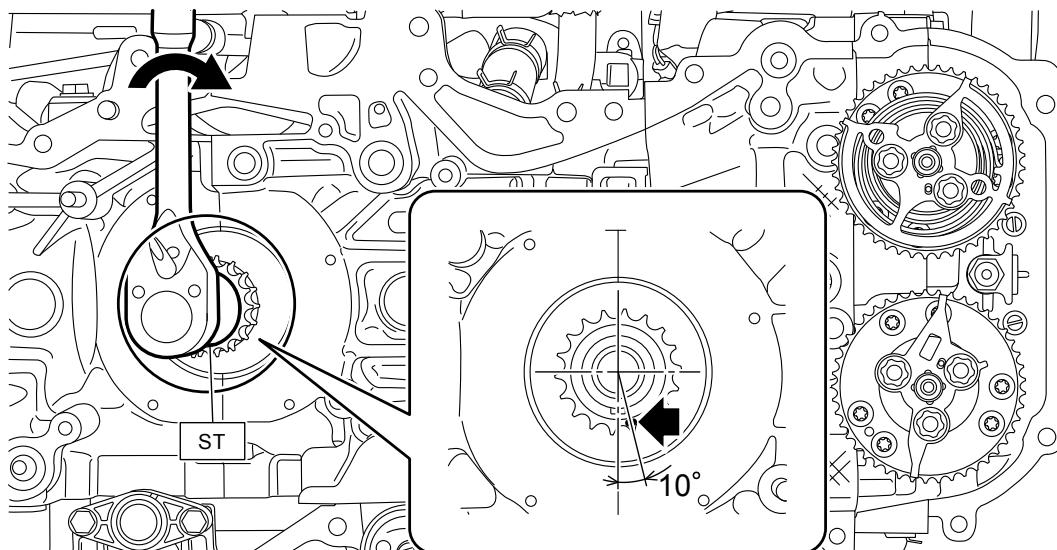
Note:

This procedure is required to prevent the valve and piston contacting with each other in the next step.

Preparation tool:

ST: CRANKSHAFT SOCKET (18252AA000)

ZD-8AJ



ME-23294

- Using ST1 and ST2, by turning the intake cam sprocket LH, align the alignment marks (protrusion) to the positions as shown in the figure.

Caution:

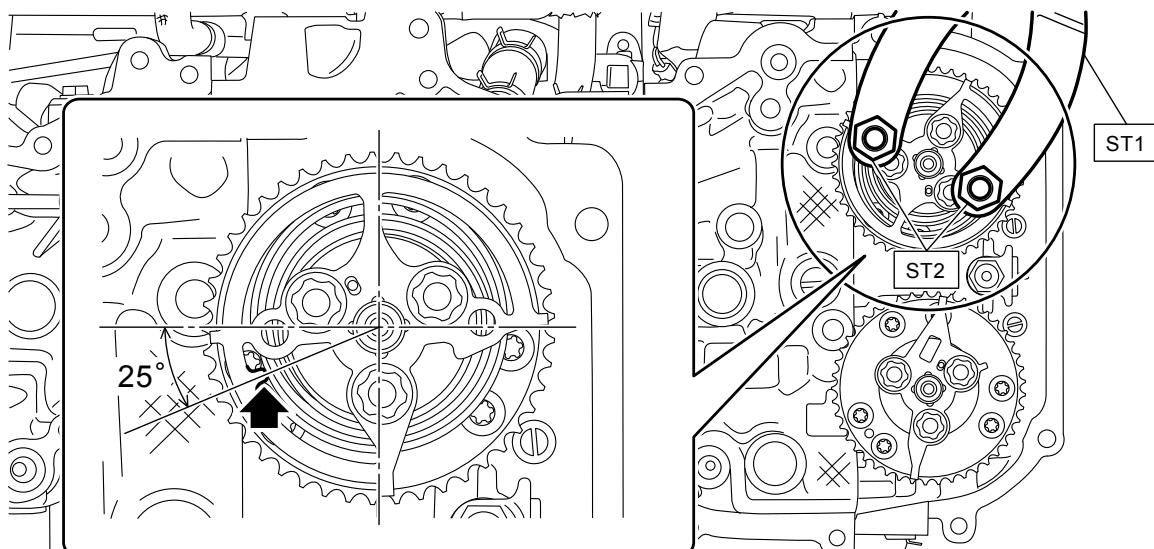
- When the intake valve and exhaust valve lift at the same time, the valve heads contact each other and valve stem may bend. Do not turn the exhaust camshaft LH.
- Perform the operation carefully since the ST comes off easily.

Preparation tool:

ST1: PULLEY WRENCH (18355AA000)

ST2: PULLEY WRENCH PIN SET (18334AA020)

ZD-8AJ



ME-23295

- Using the ST and by turning the crankshaft approximately 200° counterclockwise, align the alignment marks of crankshaft key to the positions as shown in the figure.

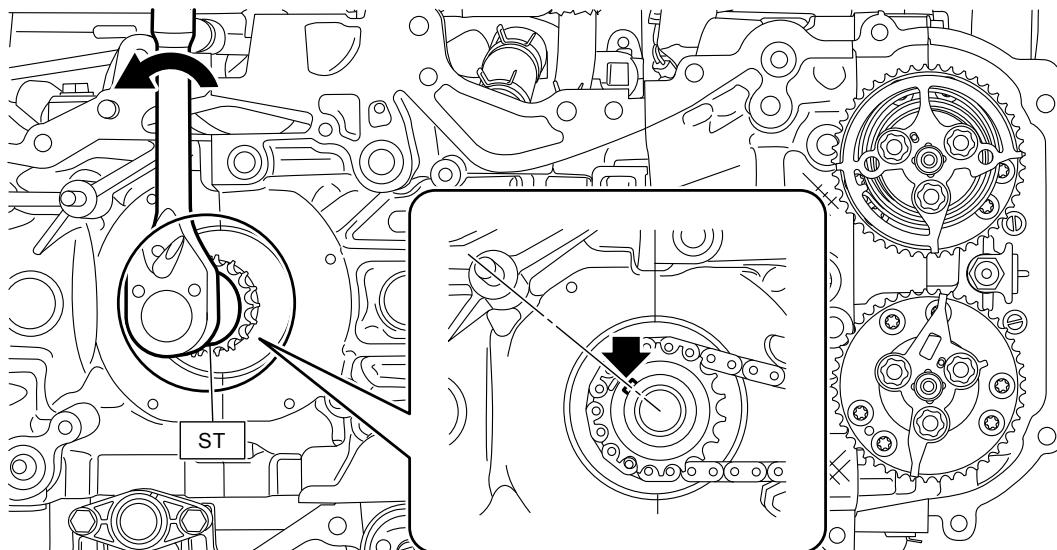
Caution:

Never turn clockwise because the valve and piston may contact. Clockwise turn is allowed only when adjusting the key position precisely, after turning the crankshaft counterclockwise to bring the key near the position as shown in the figure.

Preparation tool:

ST: CRANKSHAFT SOCKET (18252AA000)

ZD-8AJ



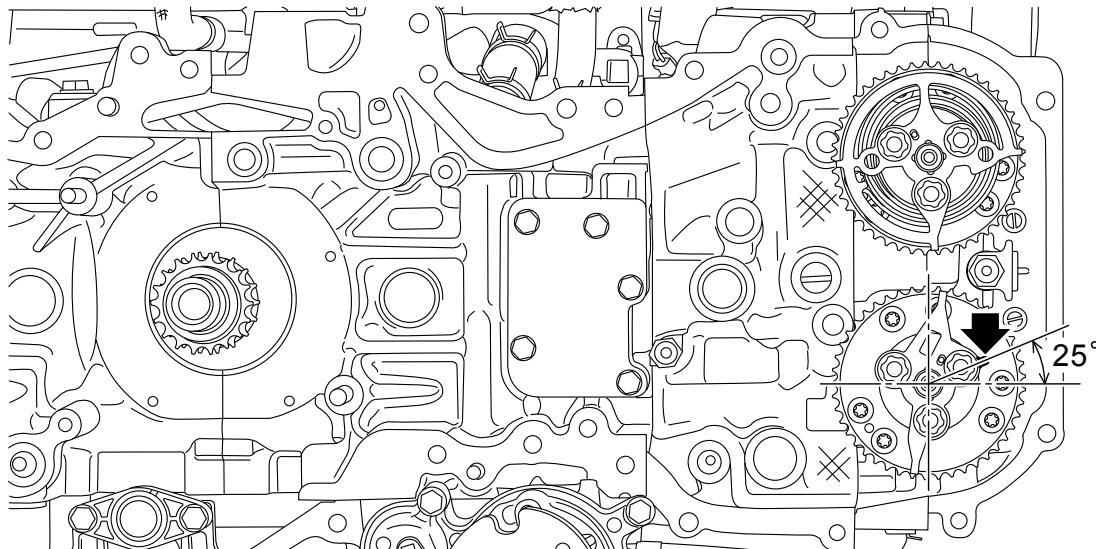
ME-23296

6. Align the alignment mark (protrusion) of exhaust cam sprocket LH to the position shown in the figure.

Caution:

To prevent valve damage, turn the exhaust cam sprocket LH only within the range of zero-lift (in range where it can be turned lightly by hand).

ZD-8AJ



ME-23297

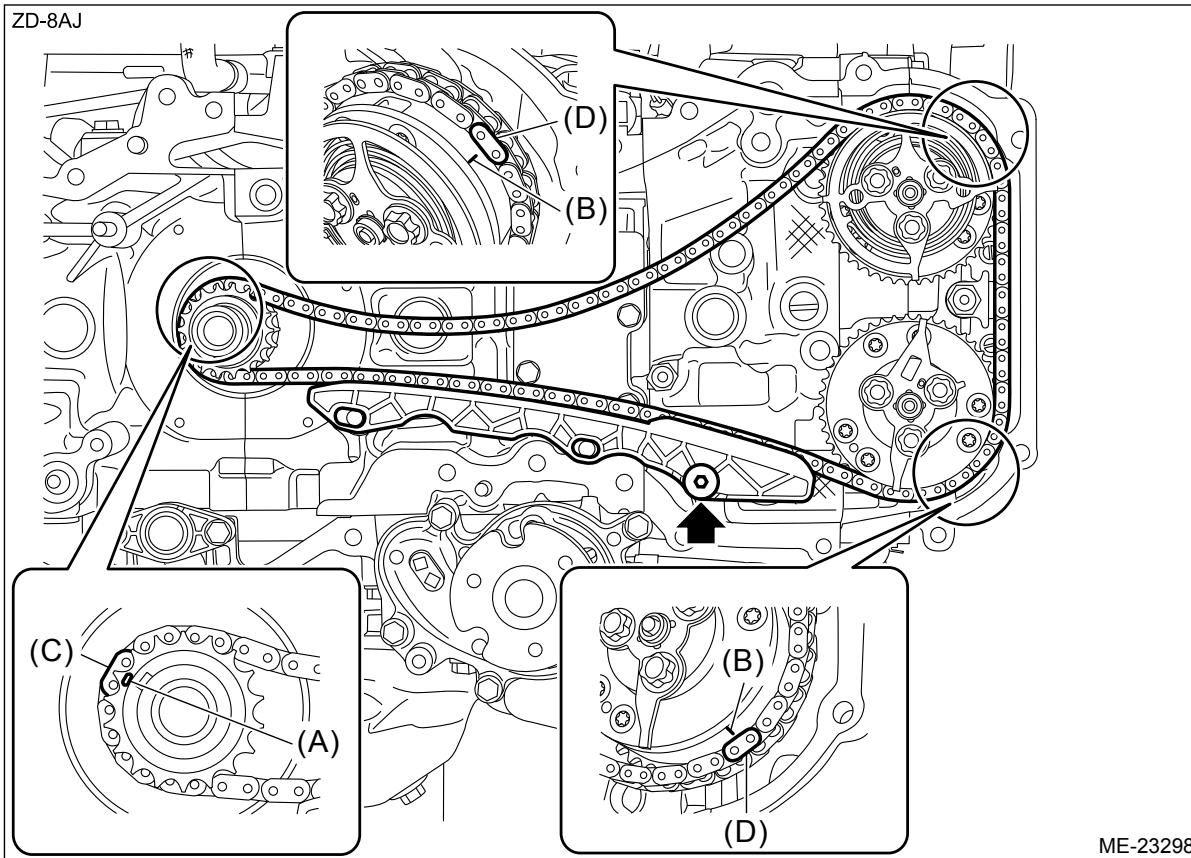
7. Install the timing chain LH and the timing chain guide LH.

- (1) Match the timing chain mark (blue) to the alignment mark of the crank sprocket.
- (2) Match the timing chain mark (pink) to the timing mark position of the intake cam sprocket LH.

- (3) Match the timing chain mark (pink) to the timing mark position of the exhaust cam sprocket LH.
 (4) Install timing chain guide LH.

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)



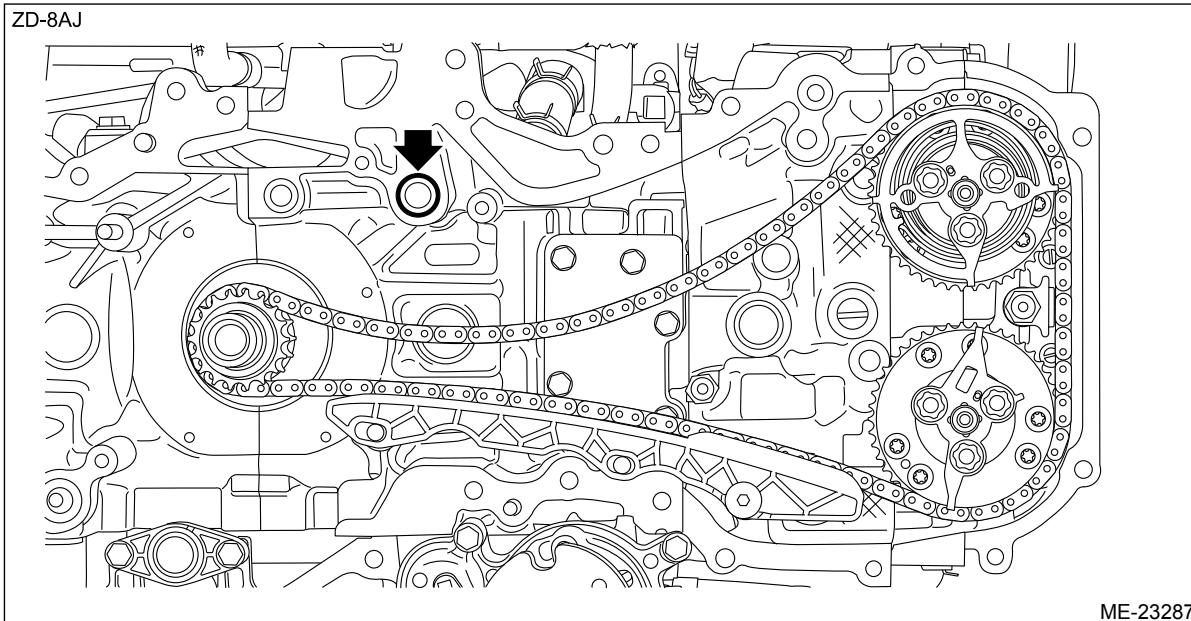
(A) Alignment mark

(C) Blue

(D) Pink

(B) Timing mark

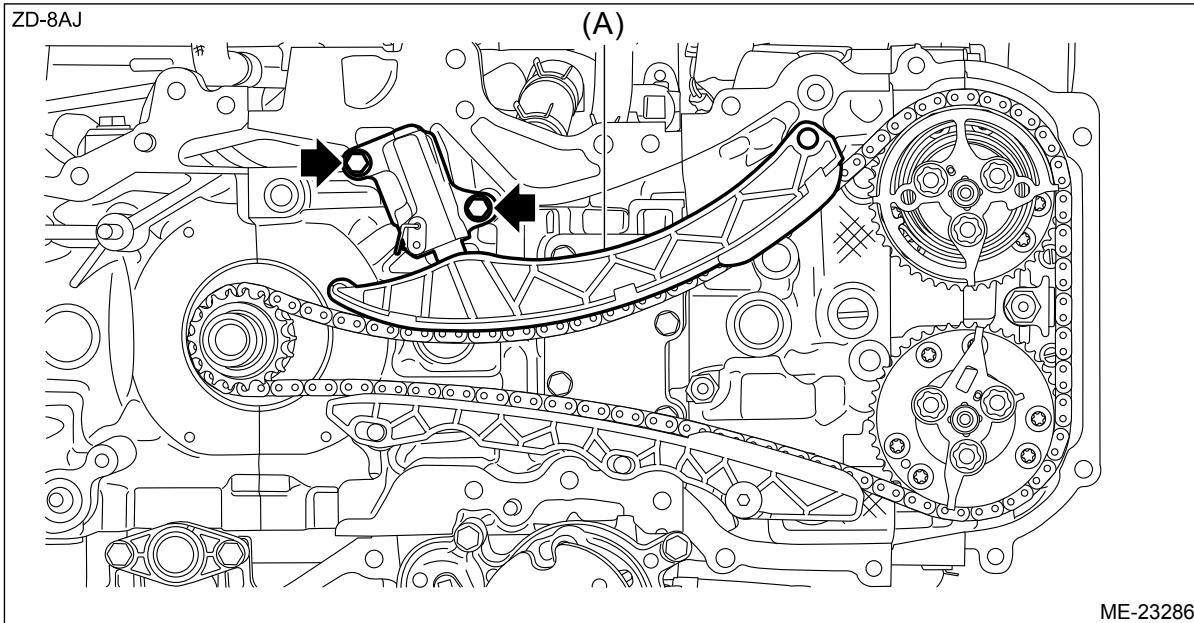
8. Install new O-rings to the cylinder block LH.



- 9.** Install the chain tensioner lever LH (A) and chain tensioner LH.

Tightening torque:

8.5 N·m (0.9 kgf-m, 6.3 ft-lb)



ME-23286

- 10.** Pull out the stopper pin from the chain tensioner LH.

Caution:

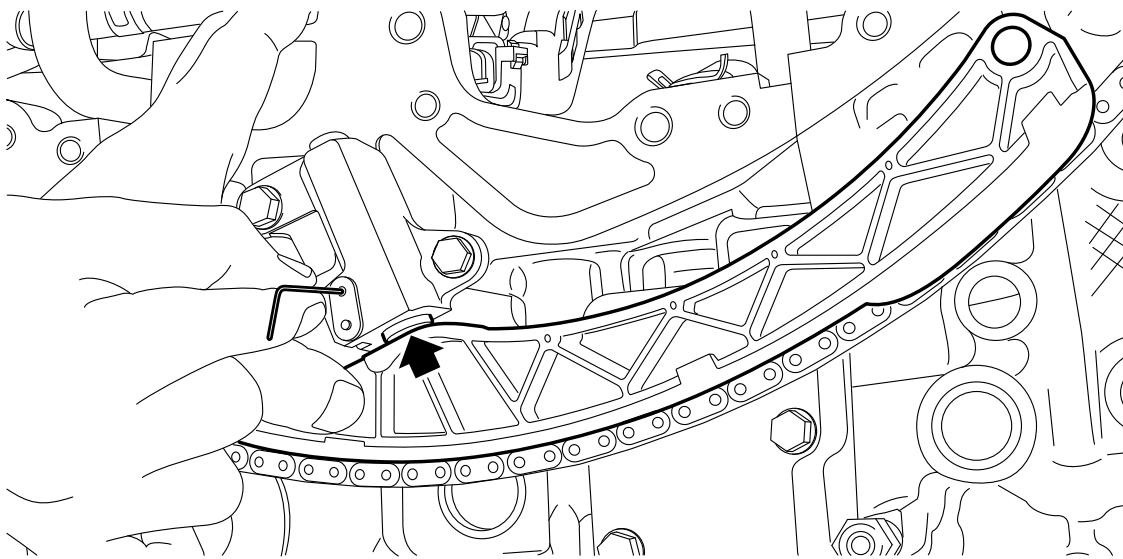
Confirm the following before pulling out the stopper pin.

- Matching of the timing chain mark (blue) to the alignment mark of the crank sprocket.
- Matching of the timing chain mark (pink) to the timing mark position of the intake cam sprocket LH.
- Matching of the timing chain mark (pink) to the timing mark position of the exhaust cam sprocket LH.

Note:

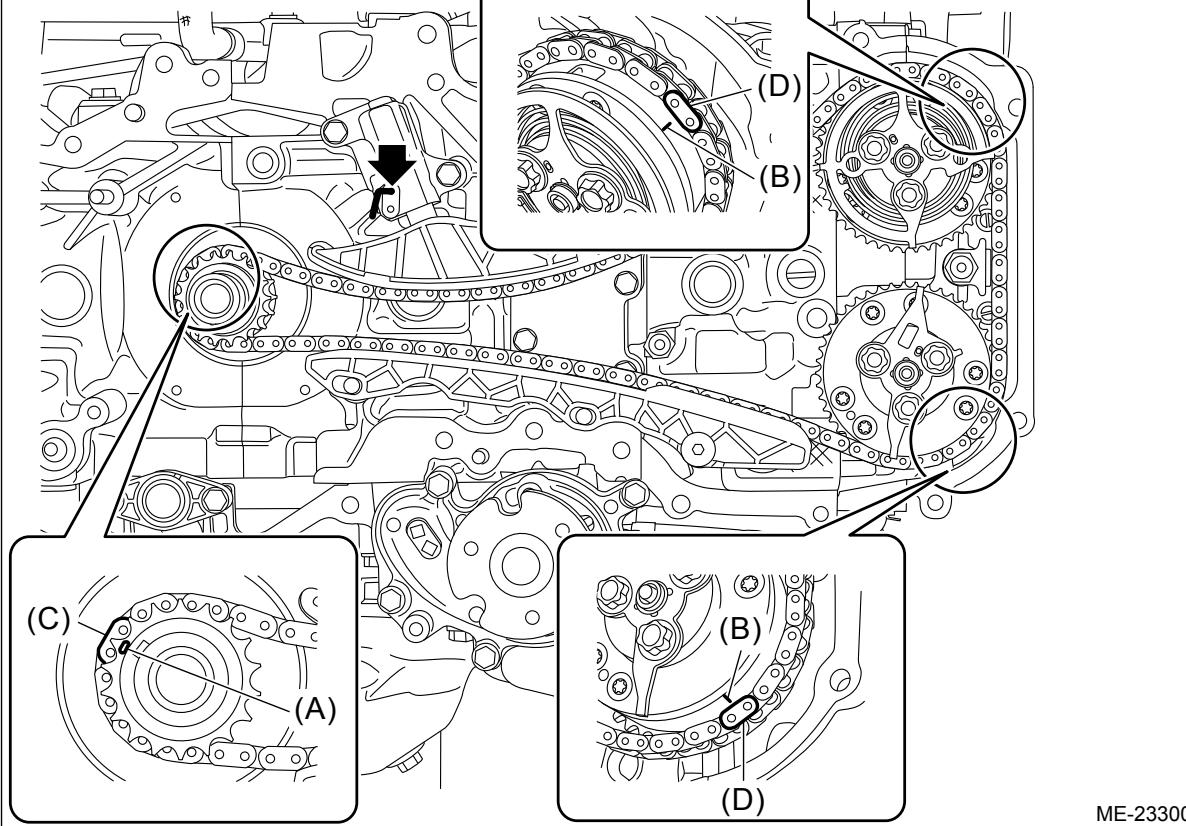
If the stopper pin cannot be removed, lift the chain tension lever LH to remove as shown in the figure.

ZD-8AJ



ME-23299

ZD-8AJ



ME-23300

(A) Alignment mark

(C) Blue

(D) Pink

(B) Timing mark

11. When the cam sprocket LH has been removed, and the cam carrier LH has been disassembled

Note:

Follow also steps below when the cam sprocket LH has been removed, and the cam carrier LH has been disassembled.

- (1) Using the ST, tighten the bolts which hold the cam sprocket LH.

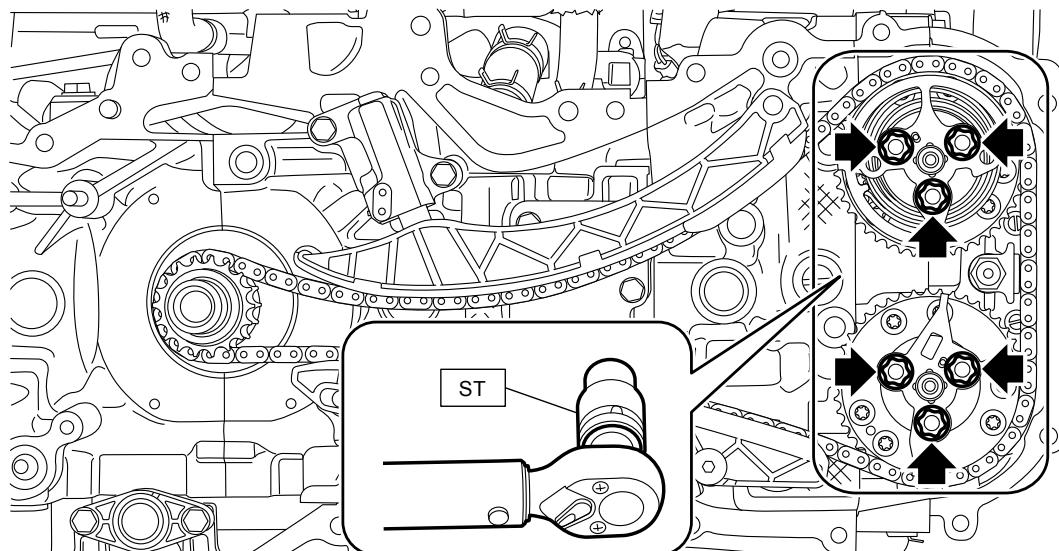
Preparation tool:

ST: SOCKET (E16) (18270KA010)

Tightening torque:

18 N·m (1.8 kgf-m, 13.3 ft-lb)

ZD-8AJ



ME-23301

12. Using the ST, turn the crankshaft clockwise, and make sure that there are no abnormal conditions.

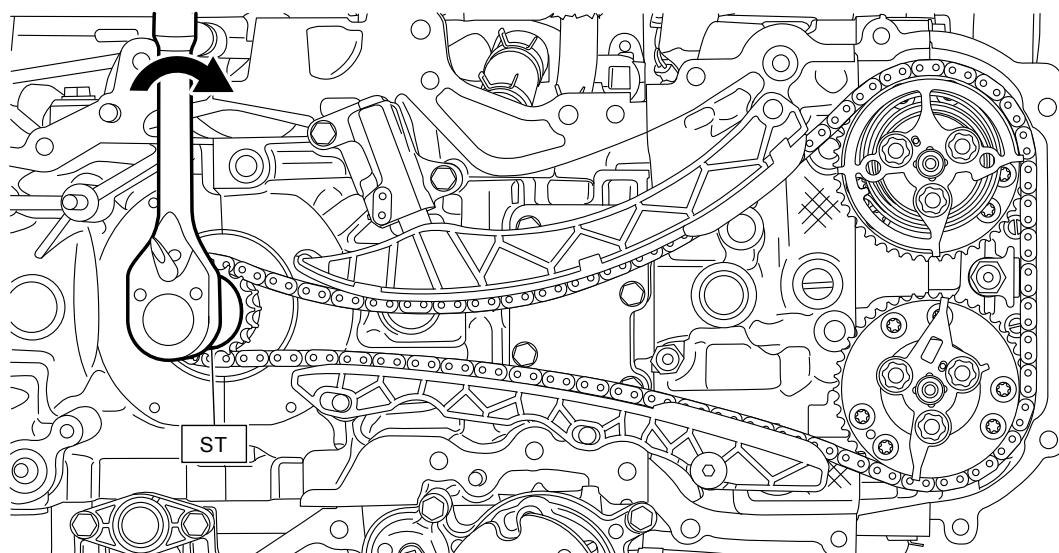
Caution:

Always make sure to perform this confirmation.

Preparation tool:

ST: CRANKSHAFT SOCKET (18252AA000)

ZD-8AJ



ME-23302

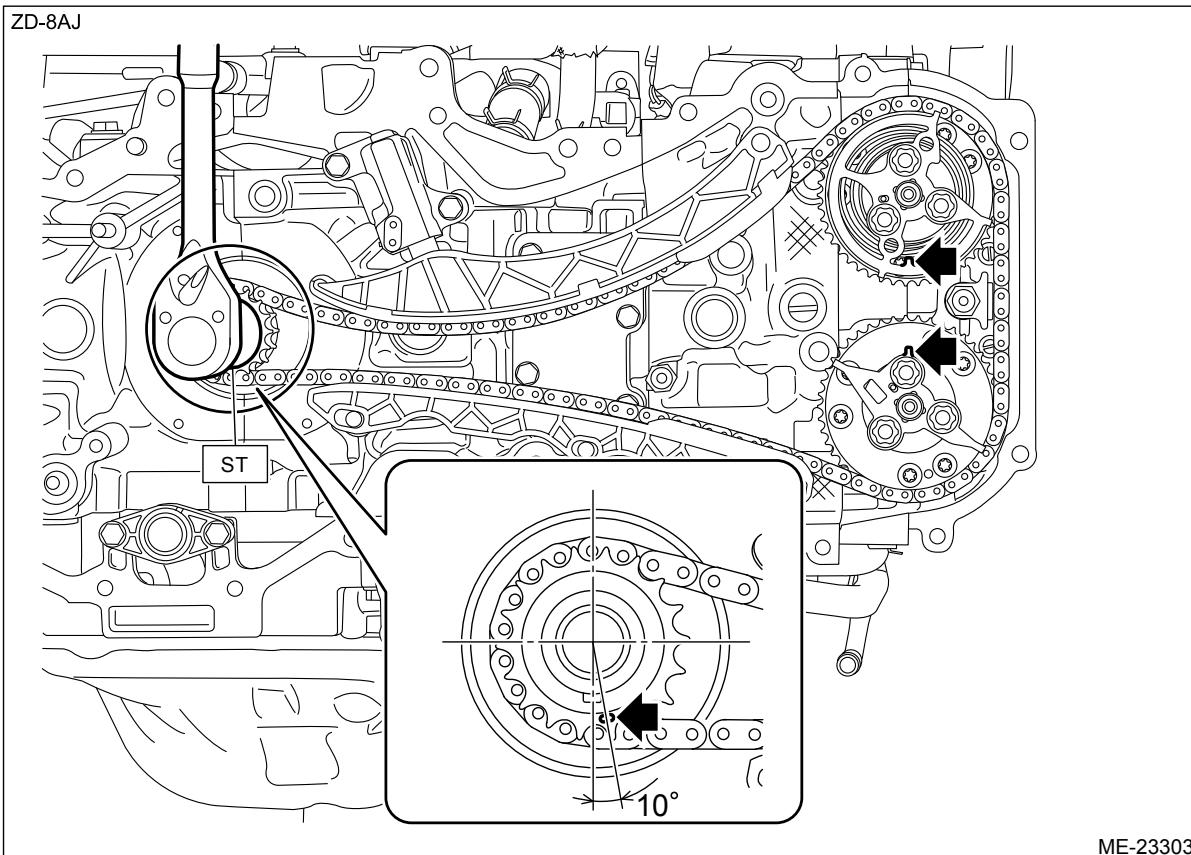
13. Using the ST and by turning the crankshaft, align the alignment mark of crank sprocket, the alignment mark (protrusion) of the intake cam sprocket LH and the alignment mark (protrusion) of the exhaust cam sprocket LH to the positions as shown in the figure.

Note:

If the alignment marks are aligned to the positions as shown in the figure, the crankshaft key is located at six o'clock position.

Preparation tool:

ST: CRANKSHAFT SOCKET (18252AA000)



ME-23303

14. Install the timing chain RH. Ref. to MECHANICAL(H4DO)>Timing Chain Assembly>INSTALLATION > [TIMING CHAIN RH.](#)

2. TIMING CHAIN RH

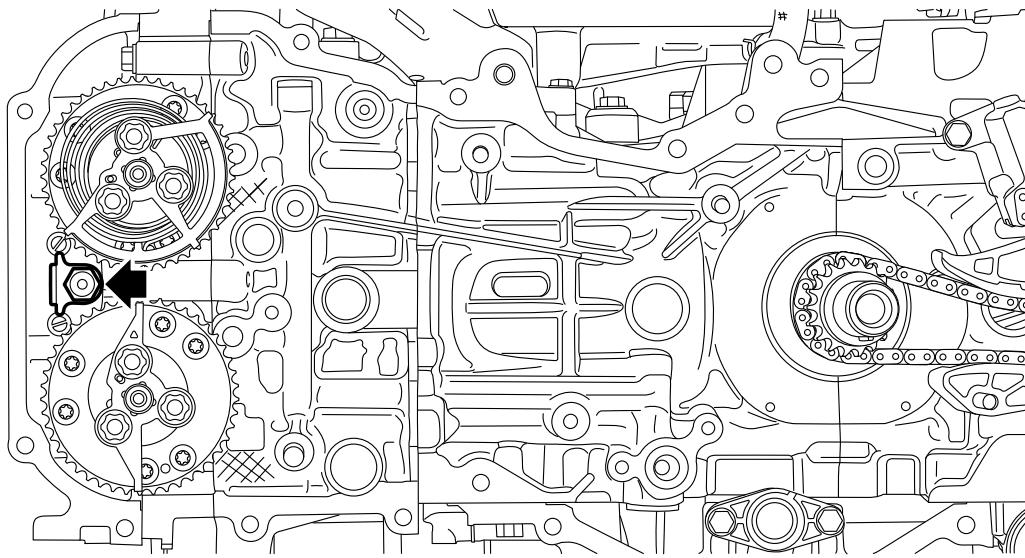
Note:

- Be careful that the foreign matter is not into or onto the assembled component during installation.
- Apply engine oil to all component parts of the timing chain.

1. Install the side chain guide RH to the front camshaft cap RH.

Tightening torque:

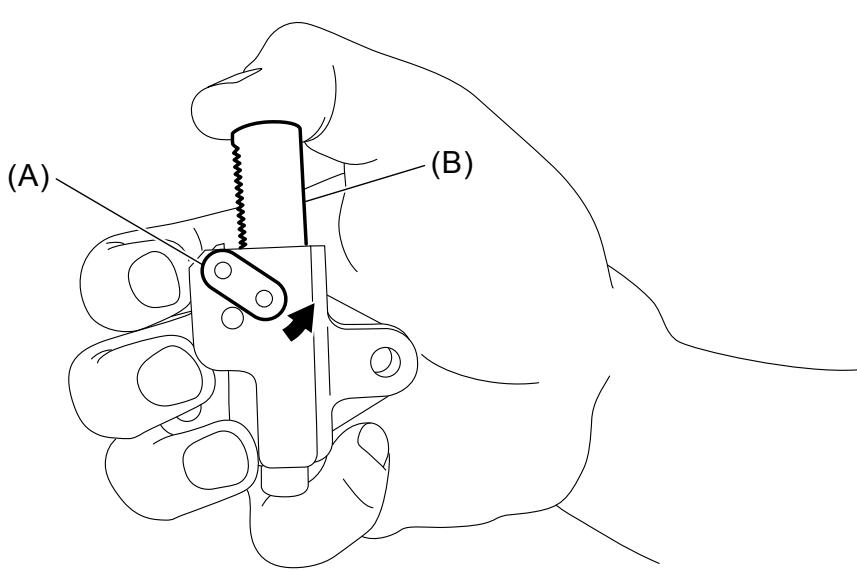
6.4 N·m (0.7 kgf-m, 4.7 ft-lb)



ME-23282

2. Install timing chain LH.  Ref. to MECHANICAL(H4DO)>Timing Chain Assembly>INSTALLATION > [TIMING CHAIN LH.](#)
3. Prepare to attach the chain tensioner RH.

(1) Press the link plate (A) in the direction of arrow to insert the plunger (B).



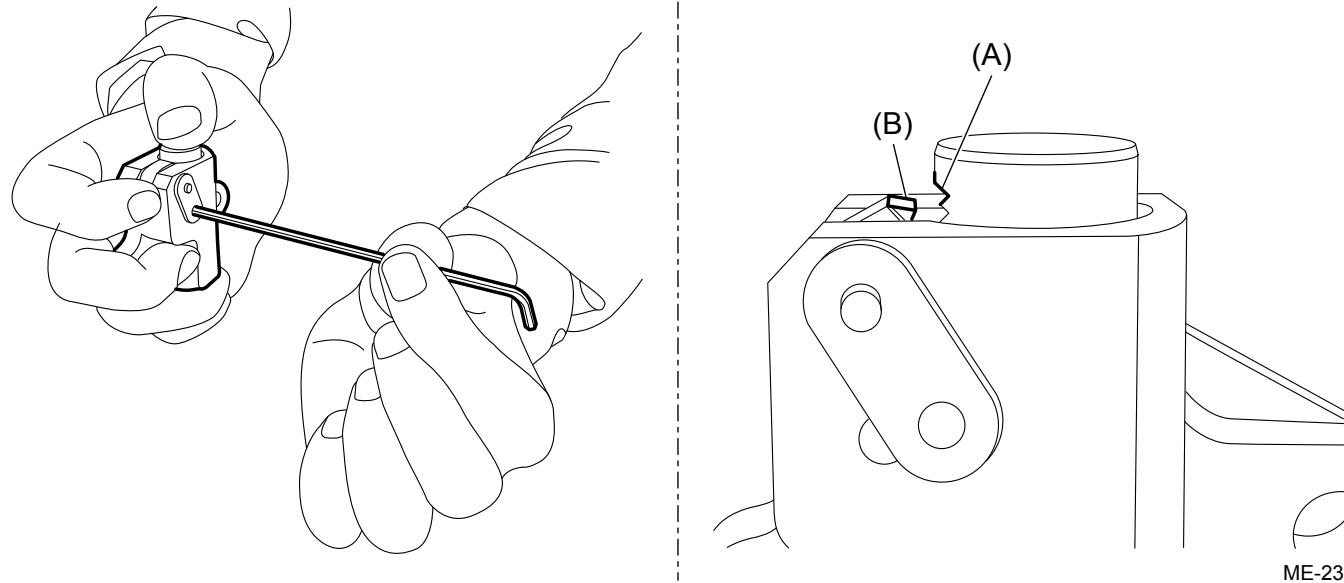
ME-21510

(2) In order to secure the plunger, insert a stopper pin with a diameter of 2.5 mm (0.0984 in) or a hex wrench with a diameter of 2.5 mm into the stopper pin hole.

Note:

If the stopper pin hole on the link plate and the stopper pin hole on the chain tensioner are not aligned, check that the first notch of plunger rack (A) is engaged with the stopper tooth (B). If not engaged, retract the plunger a little so that the first notch of plunger rack (A) is engaged with the stopper tooth (B).

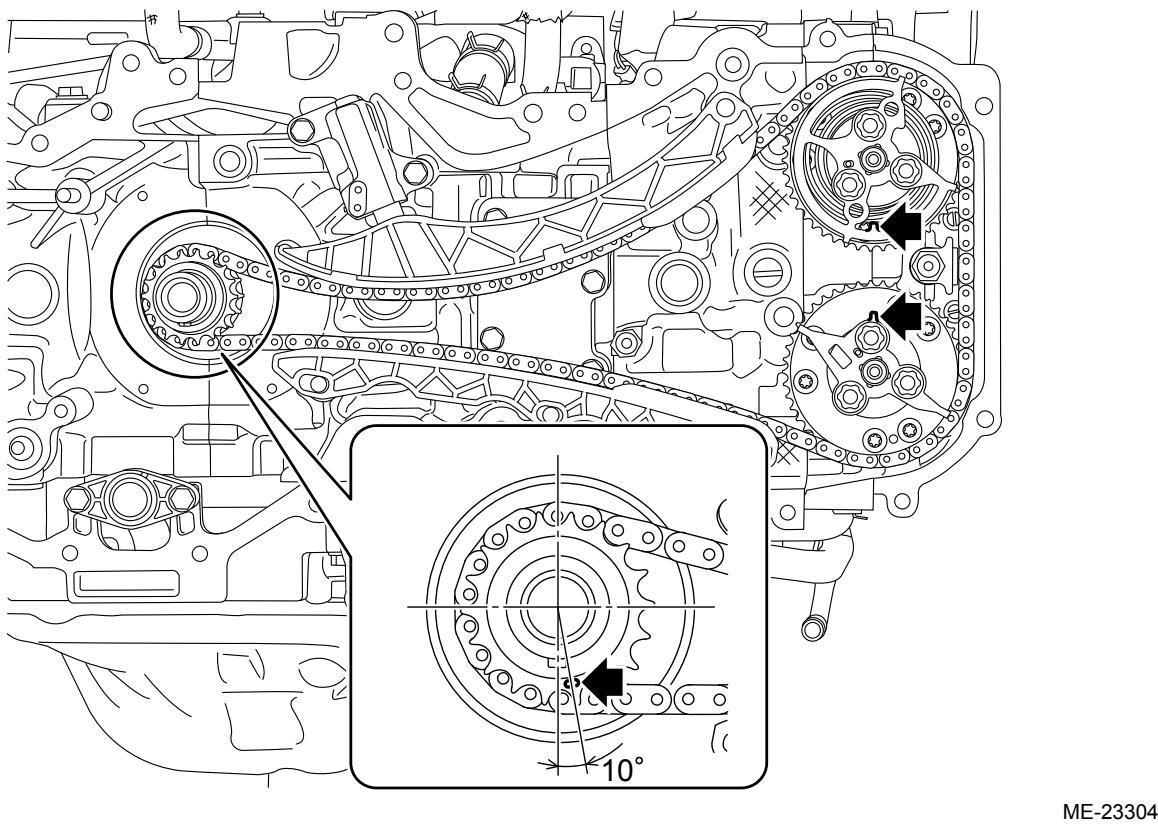
ZD-8AJ



ME-23318

4. Make sure that the alignment mark of the crank sprocket, the alignment mark (protrusion) of the intake cam sprocket LH and the alignment mark (protrusion) of the exhaust cam sprocket LH are aligned to the positions as shown in the figure.

ZD-8AJ

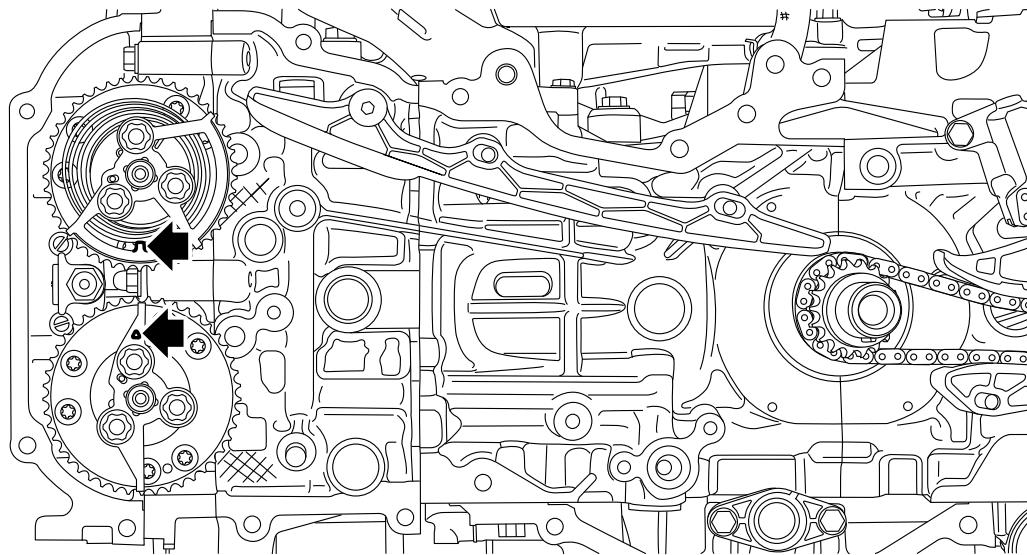


ME-23304

5. Align the alignment mark (protrusion) of the intake cam sprocket RH and the alignment mark (\triangle mark) of the exhaust cam sprocket RH to the positions as shown in the figure.

Caution:

To prevent valve damage, turn the intake cam sprocket RH and exhaust cam sprocket RH only within the range of zero-lift (in range where it can be turned lightly by hand).



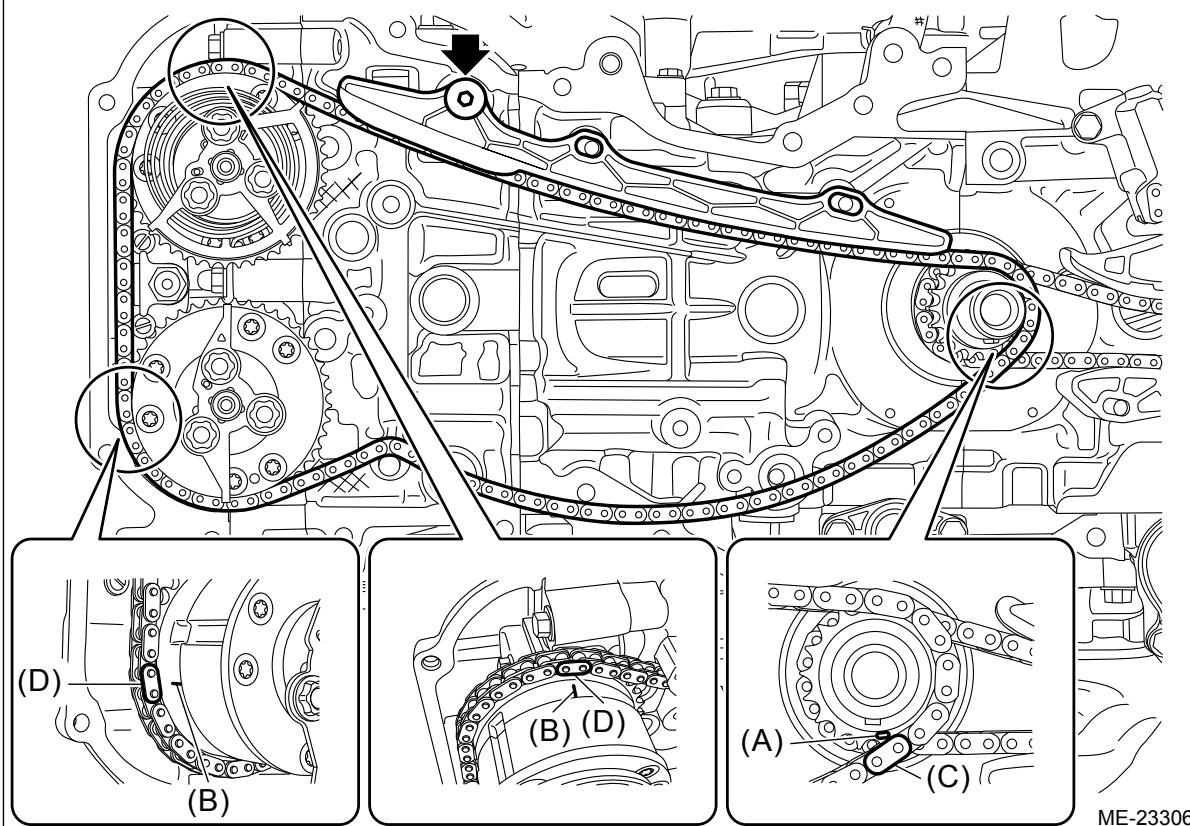
ME-23305

6. Install the timing chain RH and the timing chain guide RH.

- (1) Match the timing chain mark (blue) to the alignment mark of the crank sprocket.
- (2) Match the timing chain mark (pink) to the timing mark position of the intake cam sprocket RH.
- (3) Match the timing chain mark (pink) to the timing mark position of the exhaust cam sprocket RH.
- (4) Install the timing chain guide RH.

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)



(A) Alignment mark

(C) Blue

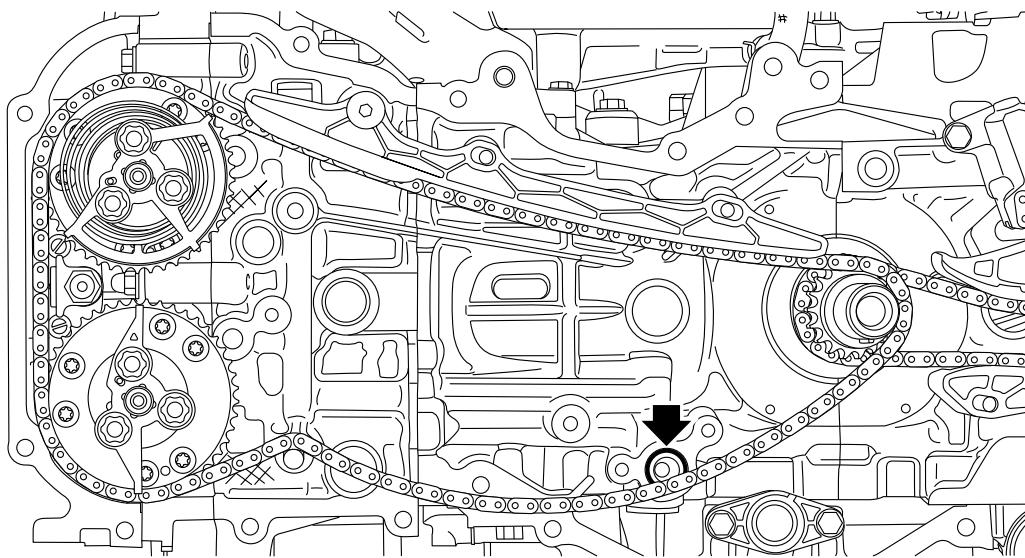
(D) Pink

ME-23306

(B) Timing mark

7. Install a new O-ring to the cylinder block RH.

ZD-8AJ



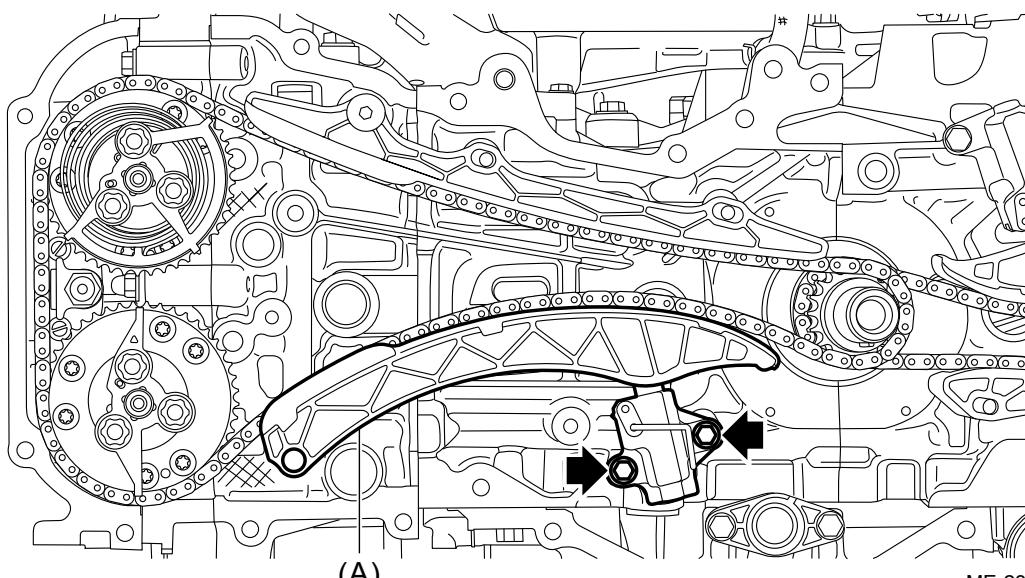
ME-23280

8. Install the chain tensioner lever RH (A) and chain tensioner RH.

Tightening torque:

8.5 N·m (0.9 kgf-m, 6.3 ft-lb)

ZD-8AJ



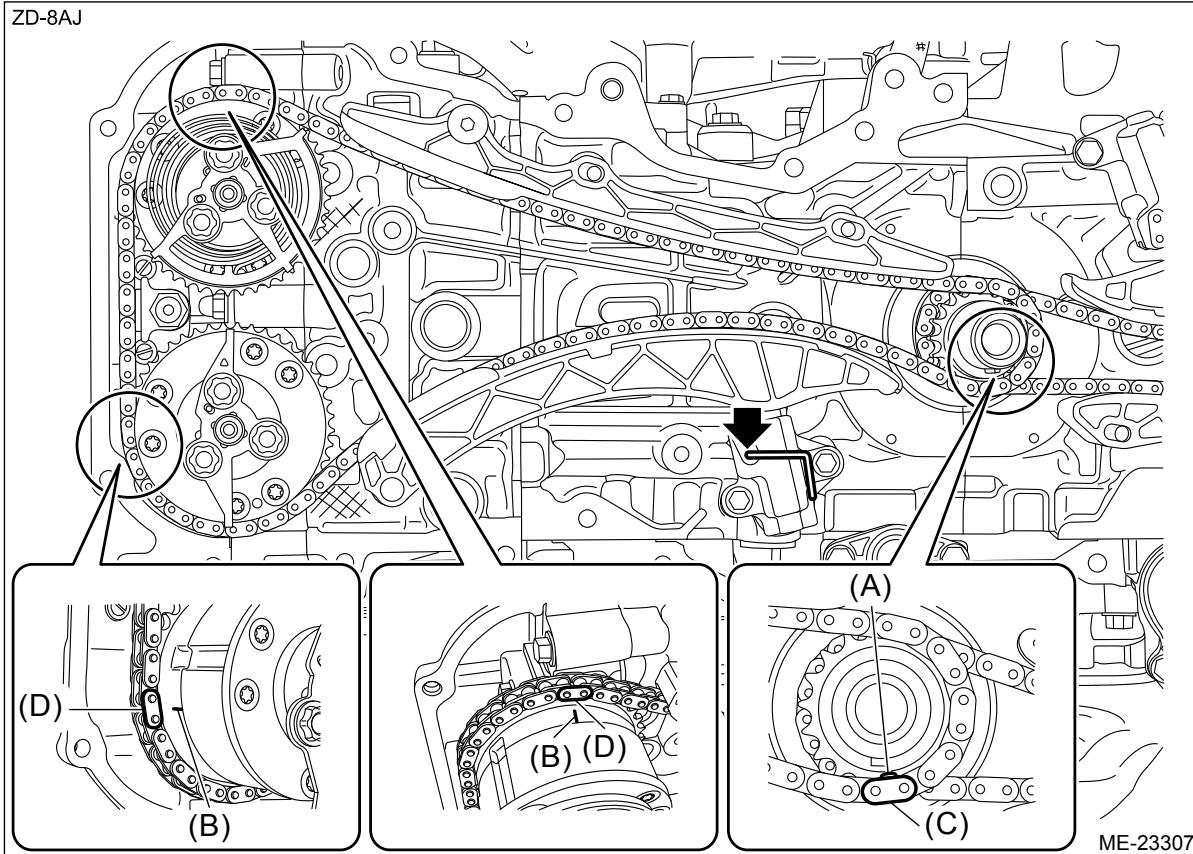
ME-23279

9. Pull out the stopper pin from the chain tensioner RH.

Caution:

Confirm the following before pulling out the stopper pin.

- Matching of the timing chain mark (blue) to the alignment mark of the crank sprocket.
- Matching of the timing chain mark (pink) to the timing mark position of the intake cam sprocket RH.
- Matching of the timing chain mark (pink) to the timing mark position of the exhaust cam sprocket RH.



ME-23307

(A) Alignment mark

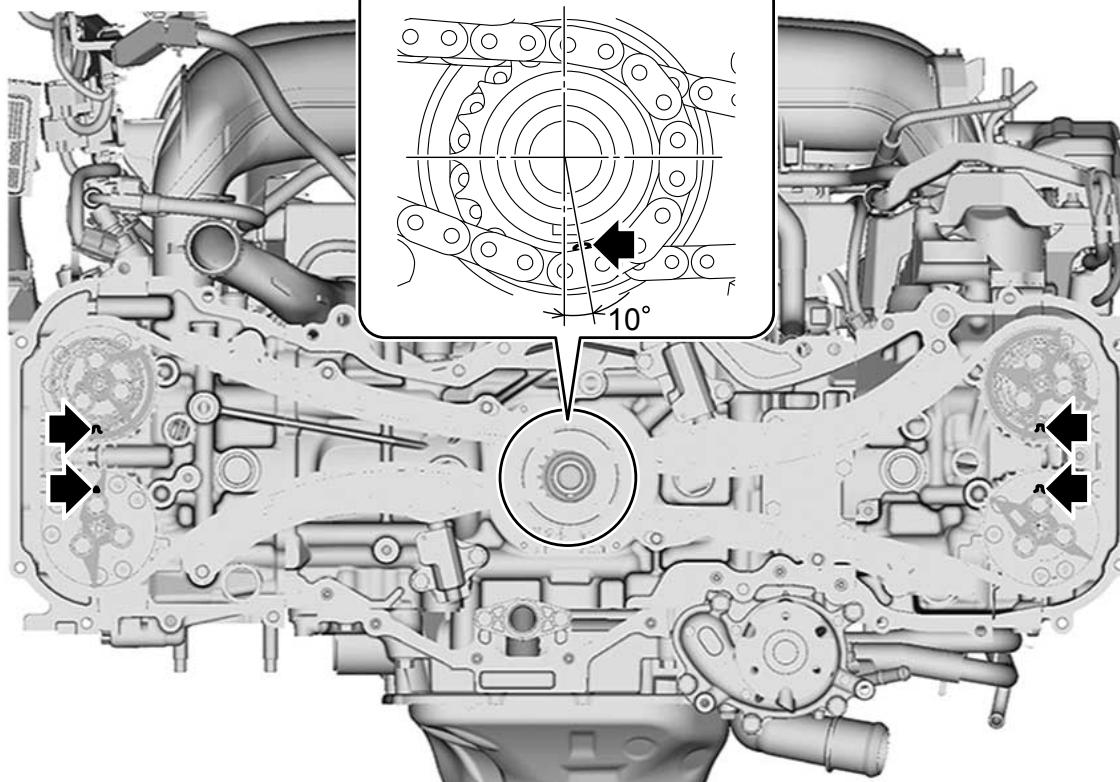
(C) Blue

(D) Pink

(B) Timing mark

10. Make sure that the alignment mark (protrusion or Δ mark) of the cam sprocket and the alignment mark (protrusion) of the crank sprocket are aligned to the positions as shown in the figure.

ZD-8AJ



ME-23308

- 11.** When the cam sprocket RH has been removed, and the cam carrier RH has been disassembled

Note:

Follow also steps below when the exhaust cam sprocket RH has been removed, and the cam carrier RH has been disassembled.

- (1) Using the ST, tighten the bolts which hold the cam sprocket RH.

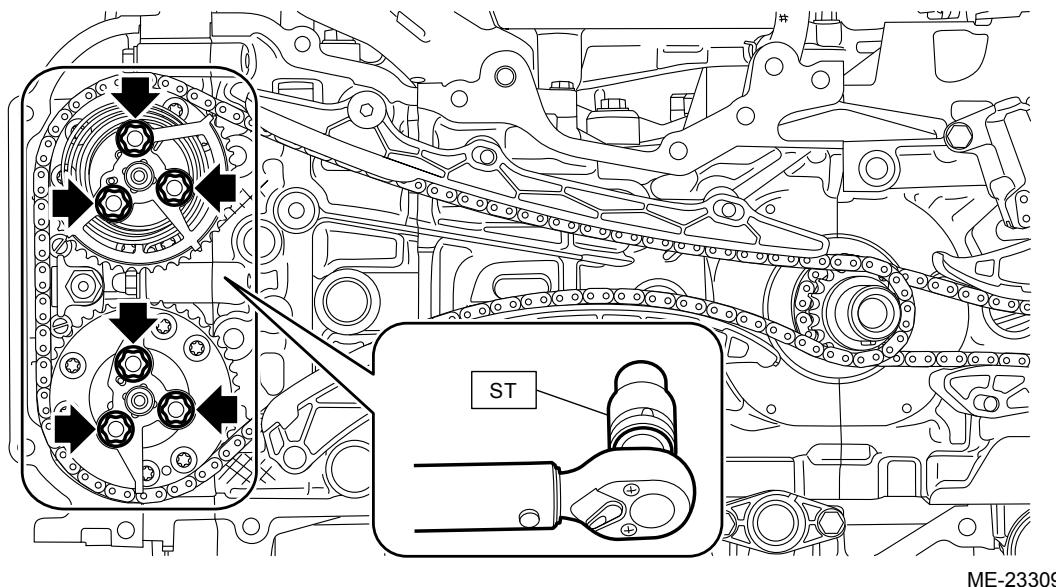
Preparation tool:

ST: SOCKET (E16) (18270KA010)

Tightening torque:

18 N·m (1.8 kgf-m, 13.3 ft-lb)

ZD-8AJ



ME-23309

- 12.** Using the ST, turn the crankshaft clockwise, and make sure that there are no abnormal conditions.

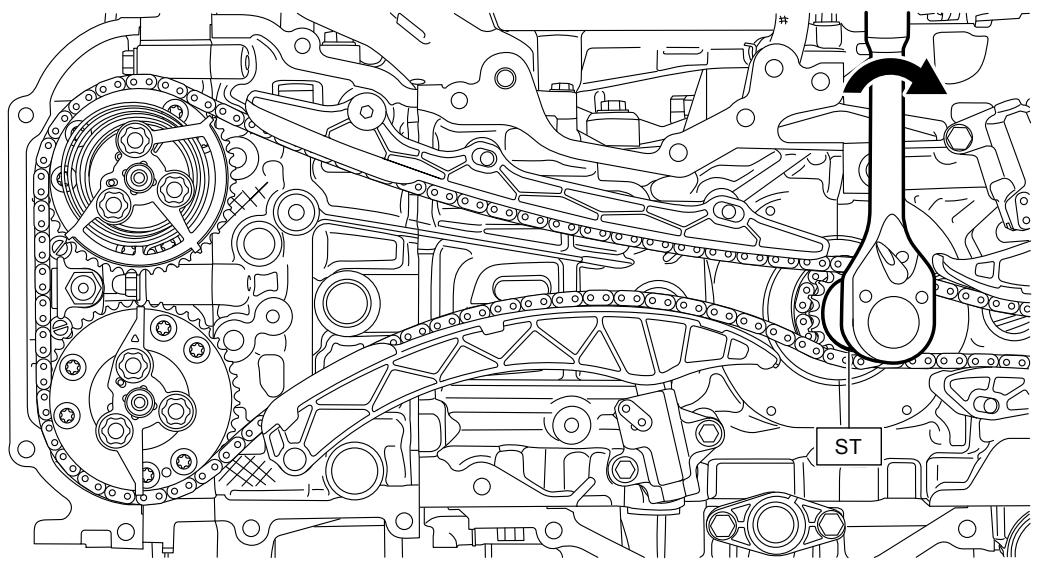
Caution:

Always make sure to perform this confirmation.

Preparation tool:

ST: CRANKSHAFT SOCKET (18252AA000)

ZD-8AJ



ME-23310

- 13.** Install the chain cover. [Ref. to MECHANICAL\(H4DO\)>Chain Cover>INSTALLATION.](#)

MECHANICAL(H4DO) > Timing Chain Assembly

INSPECTION

1. Check the timing chain, chain guide, chain tensioner lever and chain tensioner for deformation, cracks or other damages.
2. Check the chain guide and chain tensioner lever for abnormal wear.

MECHANICAL(H4DO) > Cam Sprocket

REMOVAL



1. CAM SPROCKET RH

Note:

- When replacing a single part, perform the work with the engine assembly installed to body.
- Be sure to perform the following procedures before removing the timing chain.
 1. Using the ST, loosen the bolts which hold the cam sprocket RH.

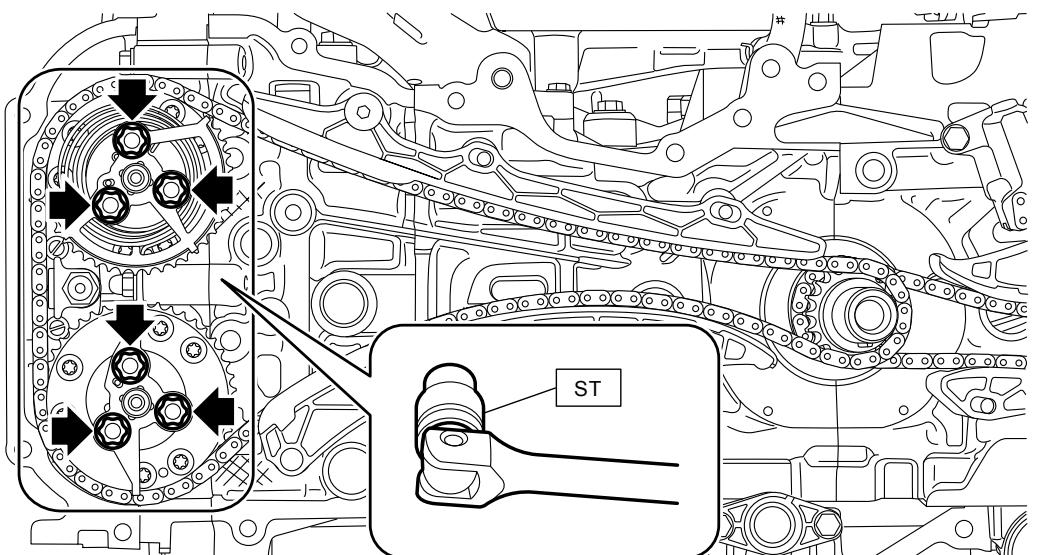
Caution:

In order to prevent damage on each component while removing the timing chain, be careful not to loosen the bolts too much.

Preparation tool:

ST: SOCKET (E16) (18270KA010)

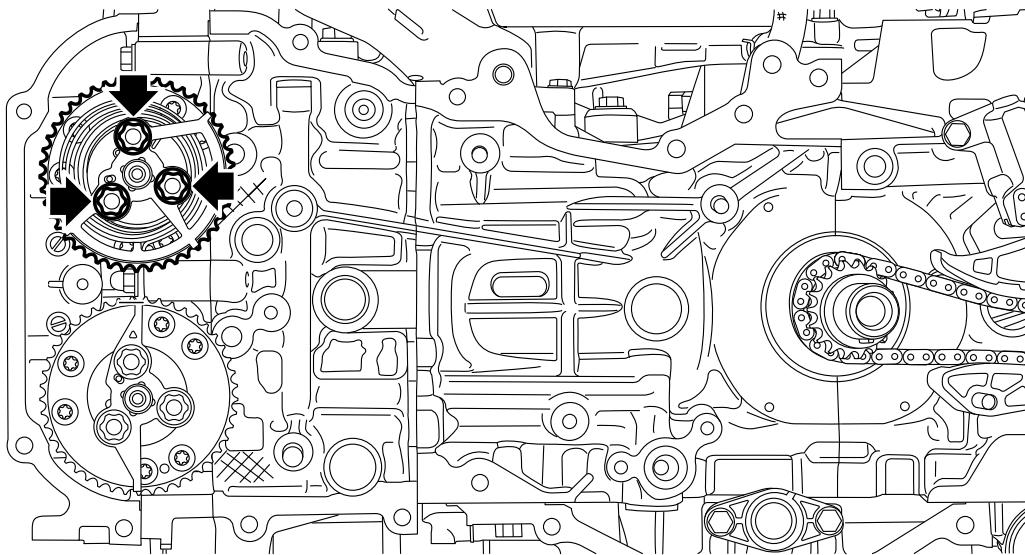
ZD-8AJ



INTAKE CAM SPROCKET RH

1. Remove the timing chain RH. Ref. to MECHANICAL(H4DO)>Timing Chain Assembly>REMOVAL > TIMING CHAIN RH.
2. Remove the intake cam sprocket RH.

ZD-8AJ

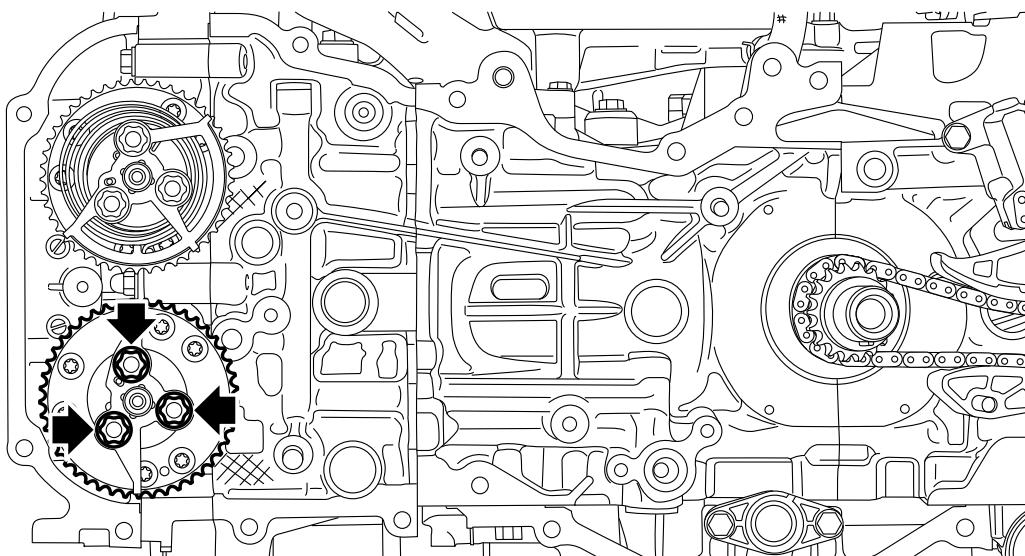


ME-23311

EXHAUST CAM SPROCKET RH

- 1.** Remove the timing chain RH.  Ref. to MECHANICAL(H4DO)>Timing Chain Assembly>REMOVAL > TIMING CHAIN RH.
- 2.** Remove the exhaust cam sprocket RH.

ZD-8AJ



ME-23312

2. CAM SPROCKET LH

Note:

- When replacing a single part, perform the work with the engine assembly installed to body.
 - Be sure to perform the following procedures before removing the timing chain.
- 1. Using the ST, loosen the bolts which hold the cam sprocket LH.**

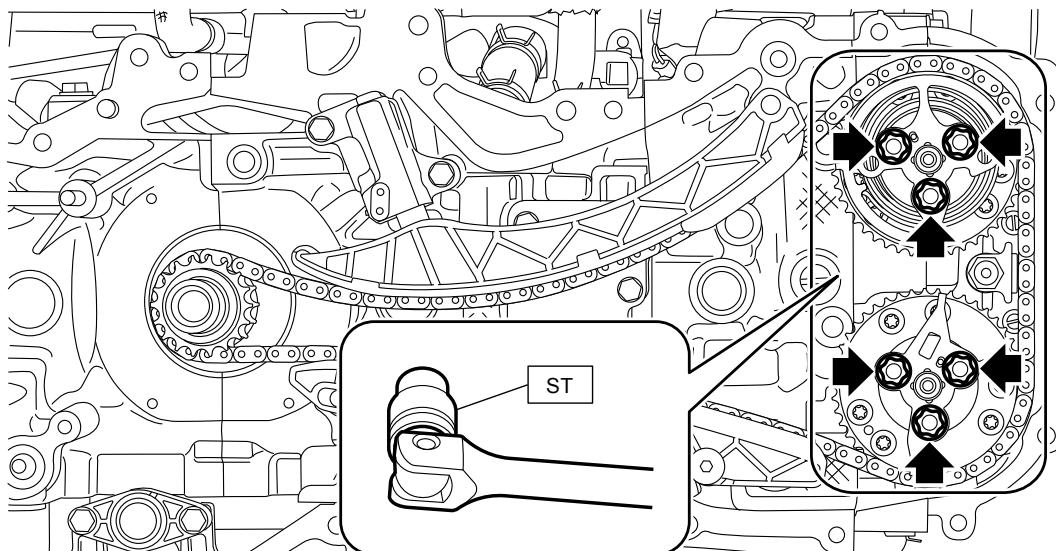
Caution:

In order to prevent damage on each component while removing the timing chain, be careful not to loosen the bolts too much.

Preparation tool:

ST: SOCKET (E16) (18270KA010)

ZD-8AJ

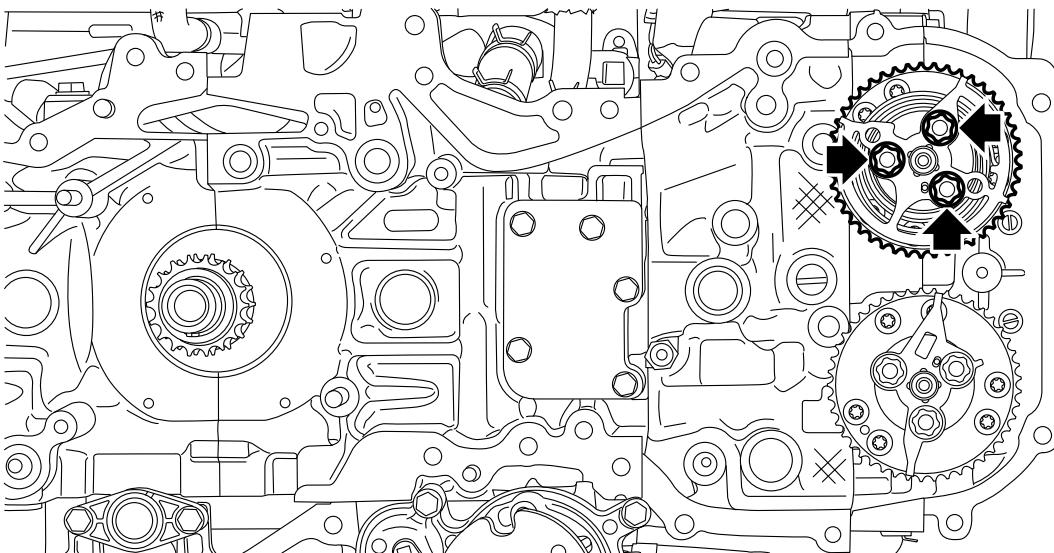


ME-23284

INTAKE CAM SPROCKET LH

1. Remove the timing chain LH. [Ref. to MECHANICAL\(H4DO\)>Timing Chain Assembly>REMOVAL > TIMING CHAIN LH.](#)
2. Remove the intake cam sprocket LH.

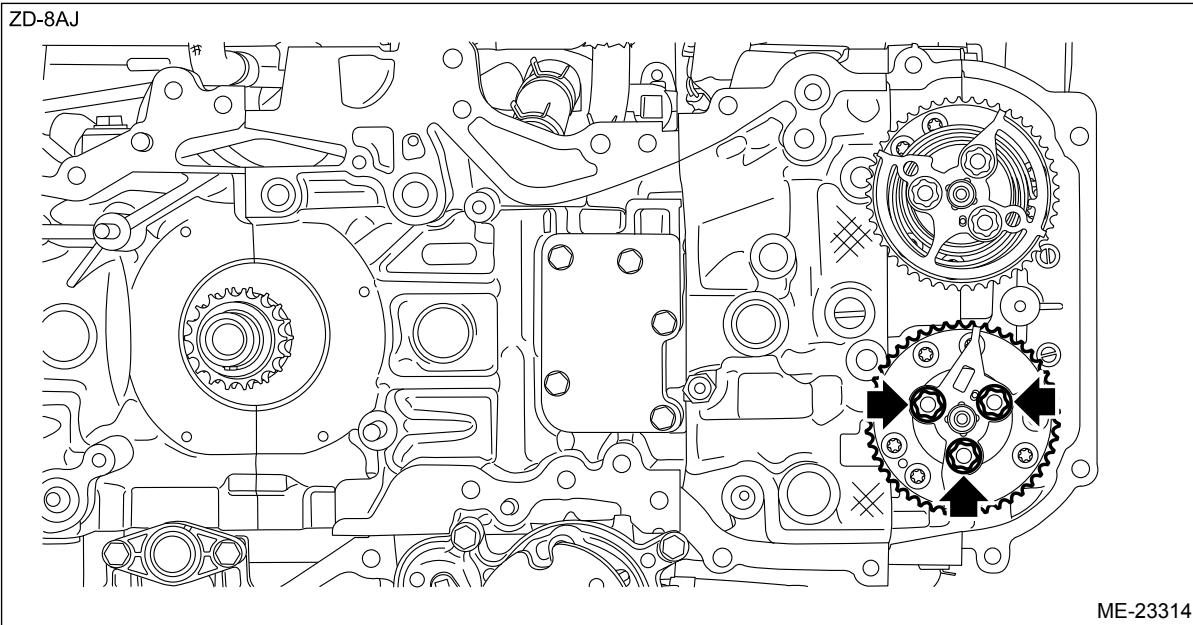
ZD-8AJ



ME-23313

EXHAUST CAM SPROCKET LH

- 1.** Remove the timing chain LH.  Ref. to MECHANICAL(H4DO)>Timing Chain Assembly>REMOVAL > [TIMING CHAIN LH.](#)
- 2.** Remove the exhaust cam sprocket LH.



MECHANICAL(H4DO) > Cam Sprocket

INSTALLATION

1. CAM SPROCKET RH

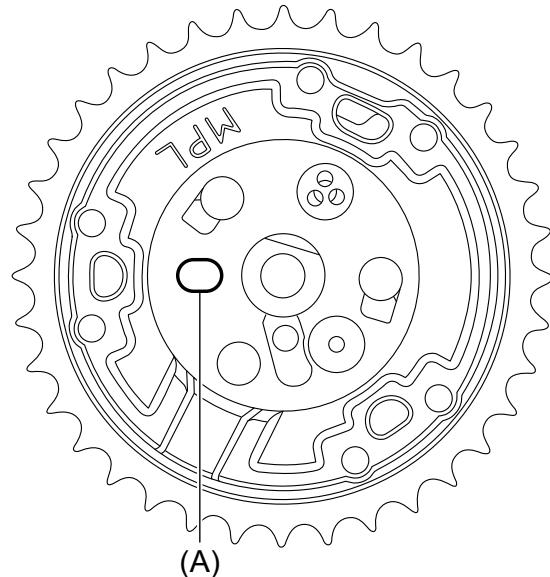
INTAKE CAM SPROCKET RH

- 1.** Install the intake cam sprocket RH by aligning the knock hole (A) of intake cam sprocket RH and the knock pin (B) of intake camshaft RH.

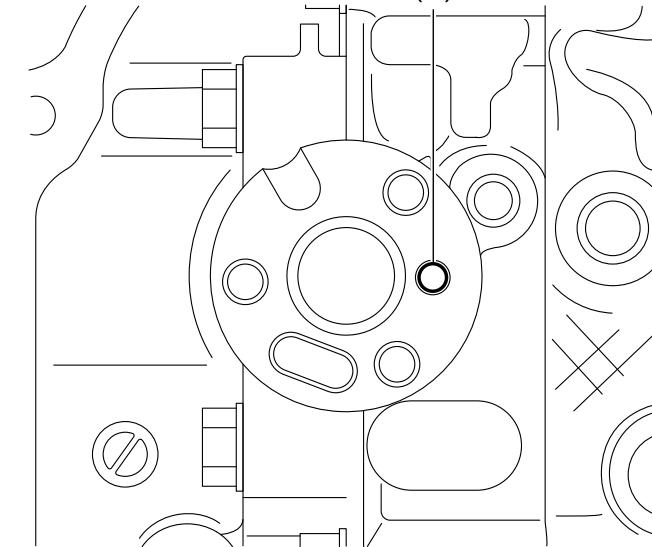
Note:

Before installation, check that there is no foreign matter on the intake cam sprocket RH and intake camshaft RH.

ZD-8AJ



(B)



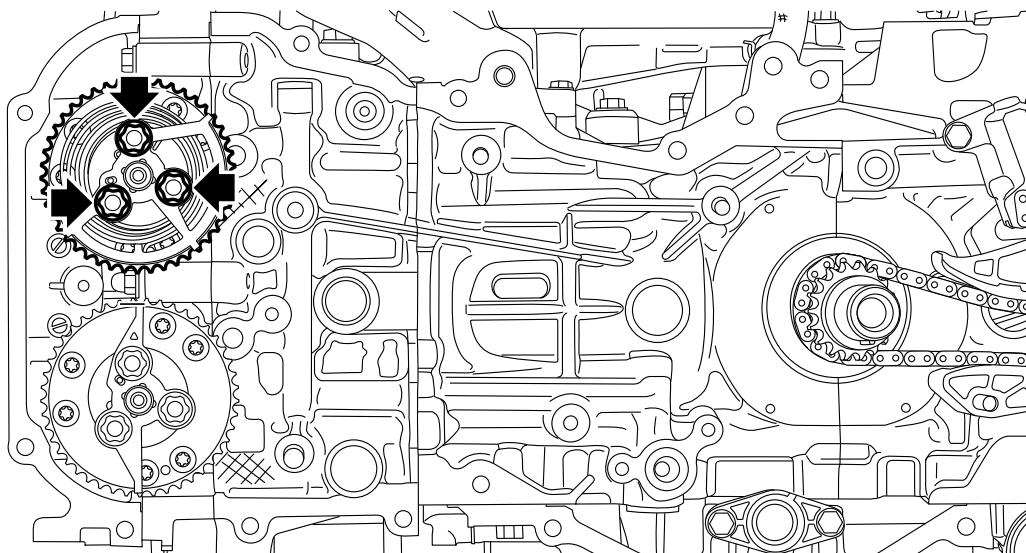
ME-23319

2. Tighten the bolts securing the intake cam sprocket RH by hand.

Note:

- **Apply a coat of engine oil to the bolt thread.**
- **Tighten the bolts until the intake cam sprocket RH contacts the intake camshaft RH by hand.**

ZD-8AJ



ME-23311

3. Install the timing chain RH. [Ref. to MECHANICAL\(H4DO\)>Timing Chain Assembly>INSTALLATION > TIMING CHAIN RH.](#)

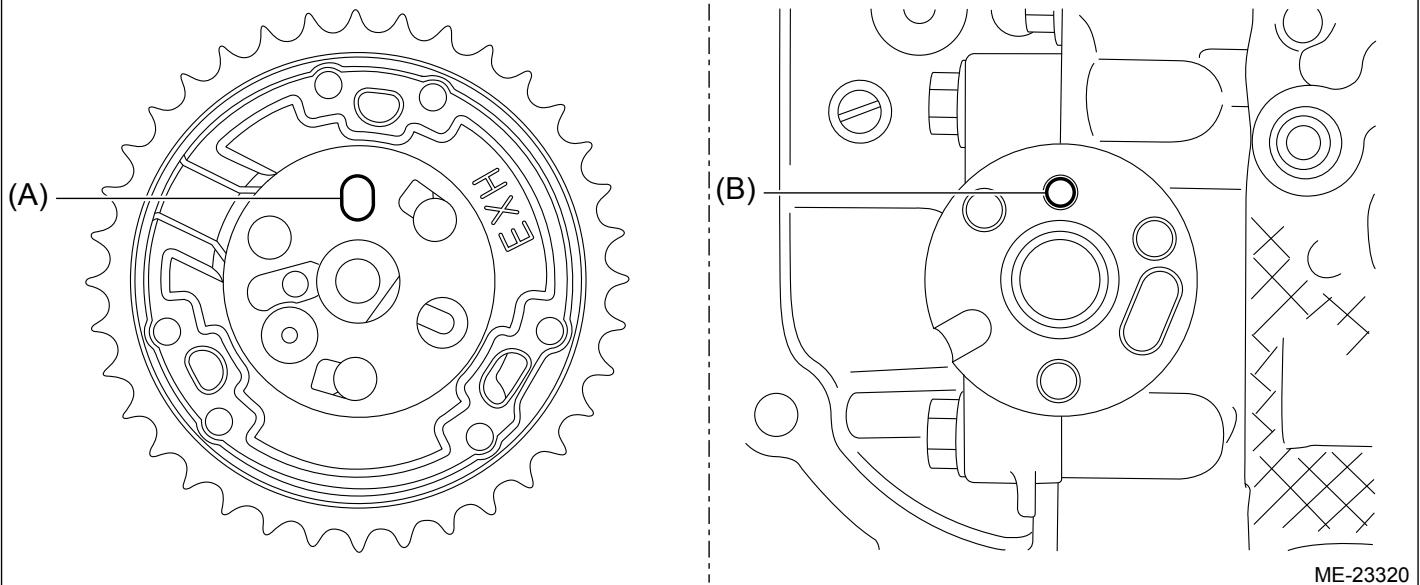
EXHAUST CAM SPROCKET RH

1. Install the exhaust cam sprocket RH by aligning the knock hole (A) of exhaust cam sprocket RH and the knock pin (B) of exhaust camshaft RH.

Note:

- Before installation, check that there is no foreign matter on the exhaust cam sprocket RH and exhaust camshaft RH.**

ZD-8AJ

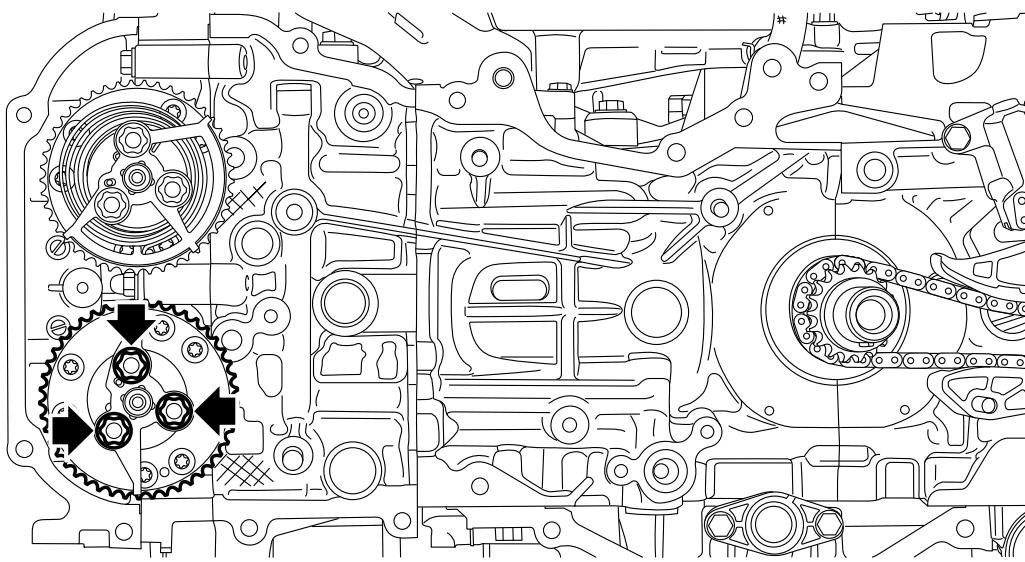


2. Tighten the bolts securing the exhaust cam sprocket RH by hand.

Note:

- **Apply a coat of engine oil to the bolt thread.**
- **Tighten the bolts until the exhaust cam sprocket RH contacts the exhaust camshaft RH by hand.**

ZD-8AJ



3. Install the timing chain RH. Ref. to MECHANICAL(H4DO)>Timing Chain Assembly>INSTALLATION > [TIMING CHAIN RH.](#)

2. CAM SPROCKET LH

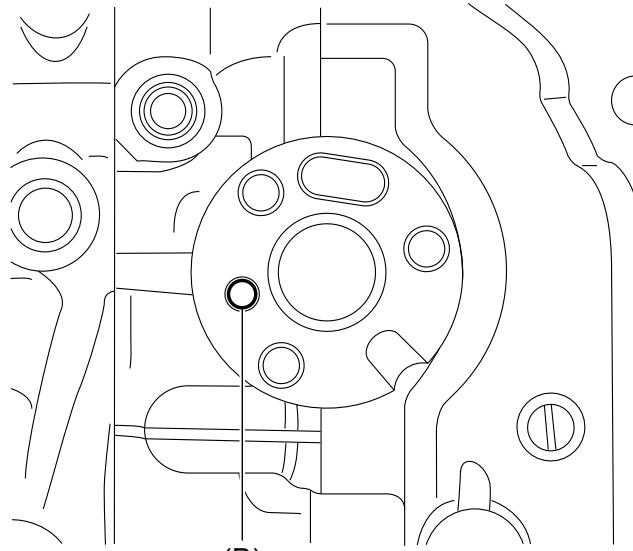
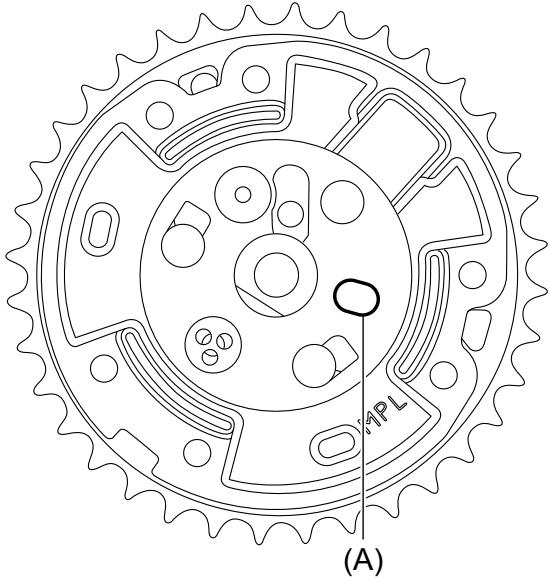
INTAKE CAM SPROCKET LH

1. Install the intake cam sprocket LH by aligning the knock hole (A) of intake cam sprocket LH and the knock pin (B) of intake camshaft LH.

Note:

Before installation, check that there is no foreign matter on the intake cam sprocket LH and intake camshaft LH.

ZD-8AJ



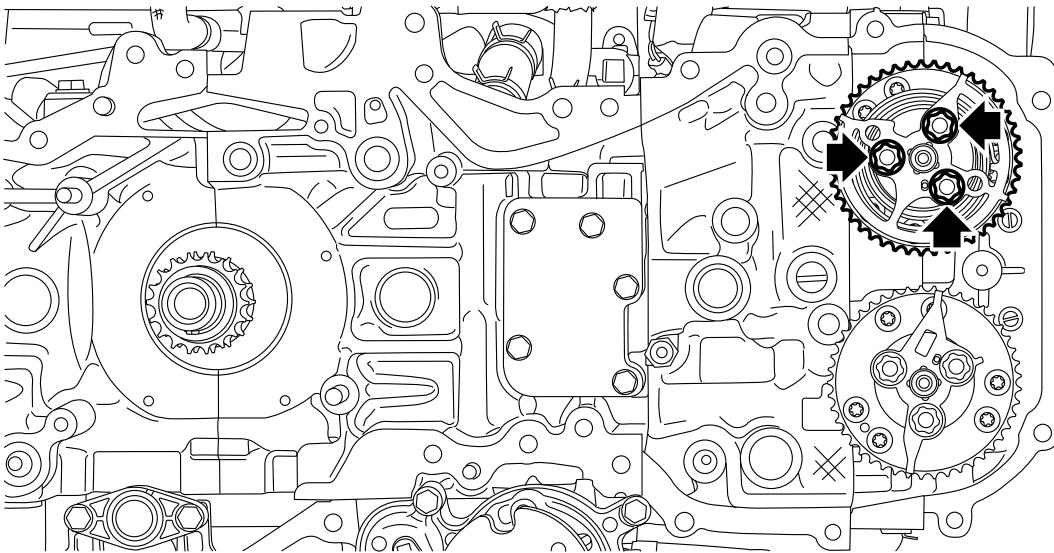
ME-23315

2. Tighten the bolts securing the intake cam sprocket LH by hand.

Note:

- **Apply a coat of engine oil to the bolt thread.**
- **Tighten the bolts until the intake cam sprocket LH contacts the intake camshaft LH by hand.**

ZD-8AJ



ME-23313

3. Install timing chain LH. [Ref. to MECHANICAL\(H4DO\)>Timing Chain Assembly>INSTALLATION > TIMING CHAIN LH.](#)

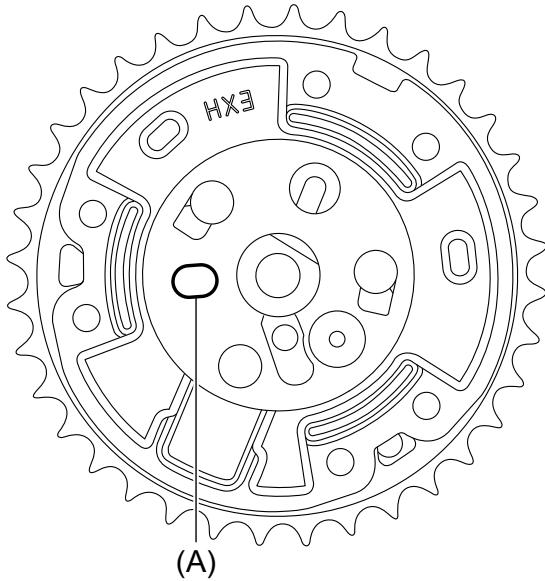
EXHAUST CAM SPROCKET LH

1. Install the exhaust cam sprocket LH by aligning the knock hole (A) of exhaust cam sprocket LH and the knock pin (B) of exhaust camshaft LH.

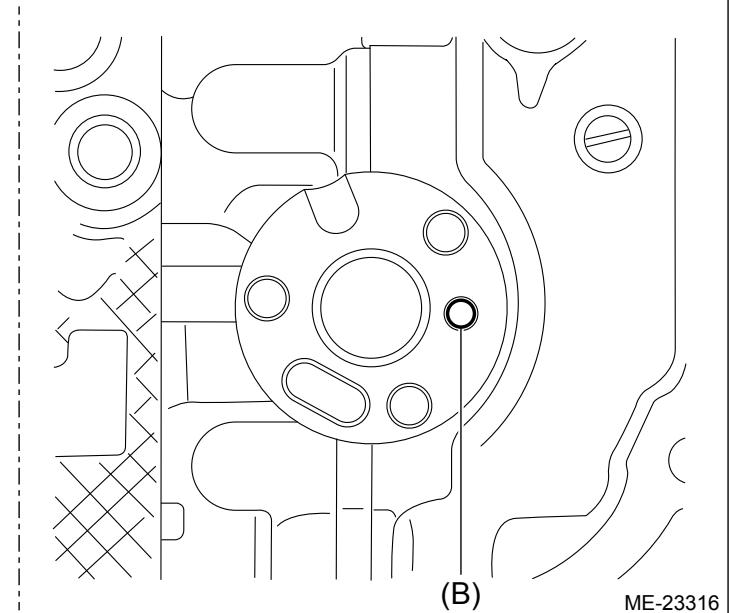
Note:

Before installation, check that there is no foreign matter on the exhaust cam sprocket LH and exhaust camshaft LH.

ZD-8AJ



(A)



(B)

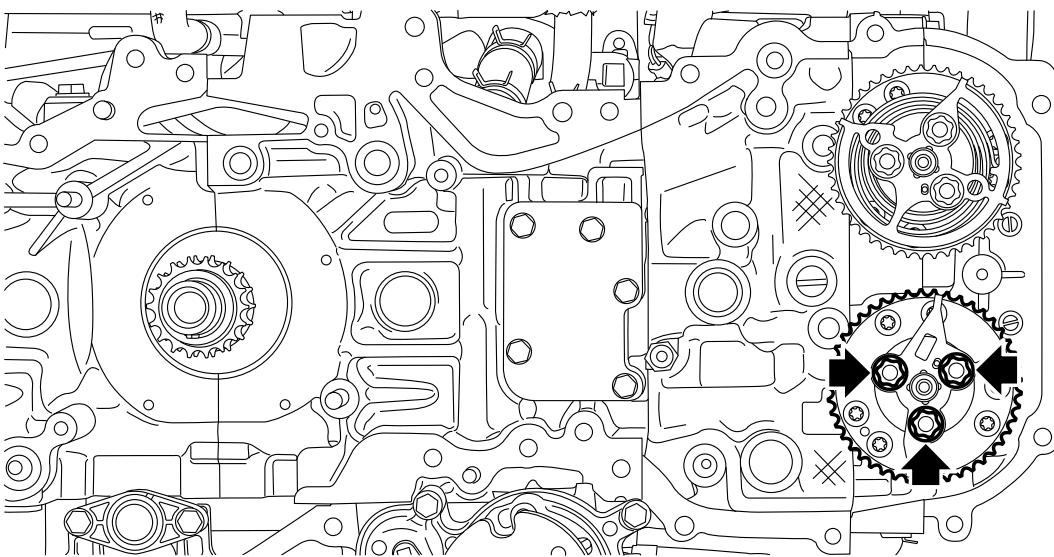
ME-23316

2. Tighten the bolts securing the exhaust cam sprocket LH by hand.

Note:

- **Apply a coat of engine oil to the bolt thread.**
- **Tighten the bolts until the exhaust cam sprocket LH contacts the exhaust camshaft LH by hand.**

ZD-8AJ



ME-23314

3. Install timing chain LH. [Ref. to MECHANICAL\(H4DO\)>Timing Chain Assembly>INSTALLATION > TIMING CHAIN LH.](#)

MECHANICAL(H4DO) > Cam Sprocket

INSPECTION

Check the cam sprocket teeth for abnormal wear and scratches.

MECHANICAL(H4DO) > Crank Sprocket

REMOVAL

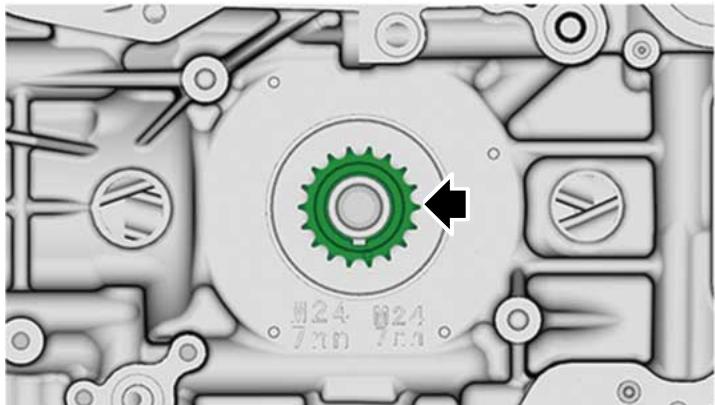


Note:

When replacing a single part, perform the work with the engine assembly installed to body.

1. Remove the timing chain.  [Ref. to MECHANICAL\(H4DO\)>Timing Chain Assembly>REMOVAL.](#)
2. Remove the crank sprocket.

ZD-8AJ



MECHANICAL(H4DO) > Crank Sprocket

INSTALLATION

1. Install the crank sprocket.

Note:

The direction of installation is not specified for the crank sprocket.

2. Install the timing chain.  [Ref. to MECHANICAL\(H4DO\)>Timing Chain Assembly>INSTALLATION.](#)

MECHANICAL(H4DO) > Crank Sprocket

INSPECTION

1. Check the crank sprocket teeth for abnormal wear and scratches.
2. Make sure there is no free play between crank sprocket and key.

MECHANICAL(H4DO) > Rocker Cover

REMOVAL



1. ROCKER COVER RH

Note:

When replacing a single part, perform the work with the engine assembly installed to body.

1. When working on the vehicle

Note:

When working on the vehicle, perform the following steps also.

- (1) Fully open the panel COMPL front hood. [Ref. to REPAIR CONTENTS>NOTE > STAY ASSEMBLY FRONT HOOD.](#)
- (2) Disconnect the ground terminal of battery sensor. [Ref. to REPAIR CONTENTS>NOTE > BATTERY.](#)
- (3) Perform the steps below to remove the air intake boot, and place it aside so that it does not interfere with the work.

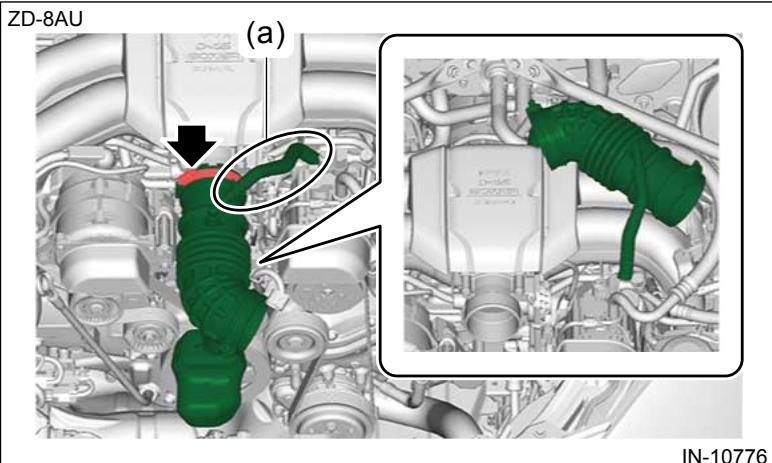
Caution:

Do not remove the PCV hose No. 2 (a).

- 1) Remove the air cleaner case. [Ref. to INTAKE \(INDUCTION\)\(H4DO\)>Air Cleaner Case>REMOVAL.](#)
- 2) Loosen the clamp, remove the air intake boot, and place it aside so that it does not interfere with the work.

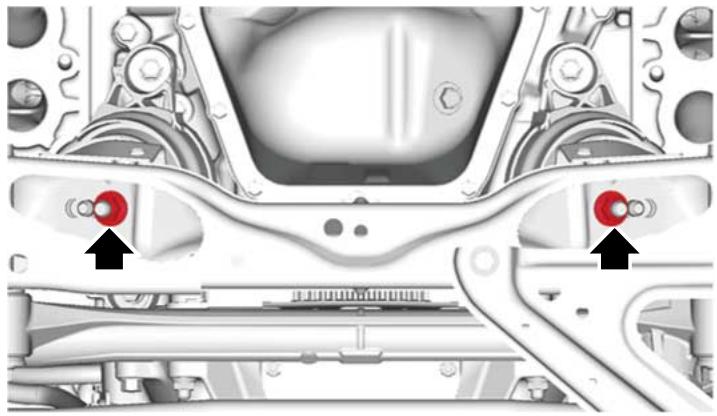
Caution:

Be careful not to pull out the PCV hose No. 2 (a).



- (4) Remove the ECM. [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>Engine Control Module \(ECM\)>REMOVAL.](#)
- (5) Remove the front exhaust pipe. [Ref. to EXHAUST\(H4DO\)>Front Exhaust Pipe>REMOVAL.](#)
- (6) Remove the nuts which secure the engine mounting to the crossmember COMPL front.

ZD-8AU

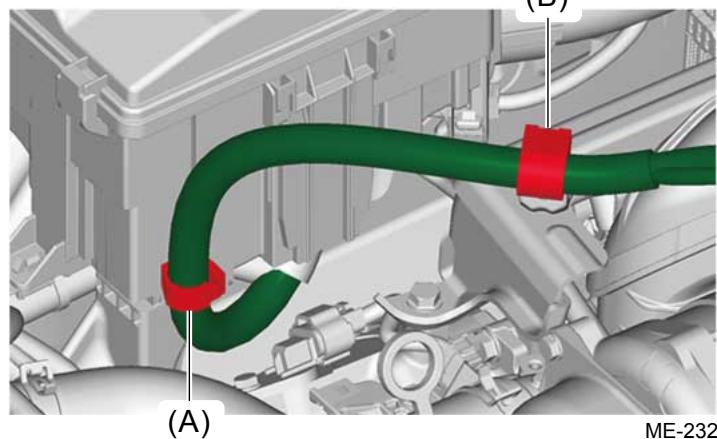


(7) Lower the vehicle.

(8) Open the claw of the clip (A) which secures the generator cord to the main fuse box and remove the generator cord.

(9) Remove the clip (B) securing the generator cord to the fuel pipe protector RH No. 1.

ZD-8AJ



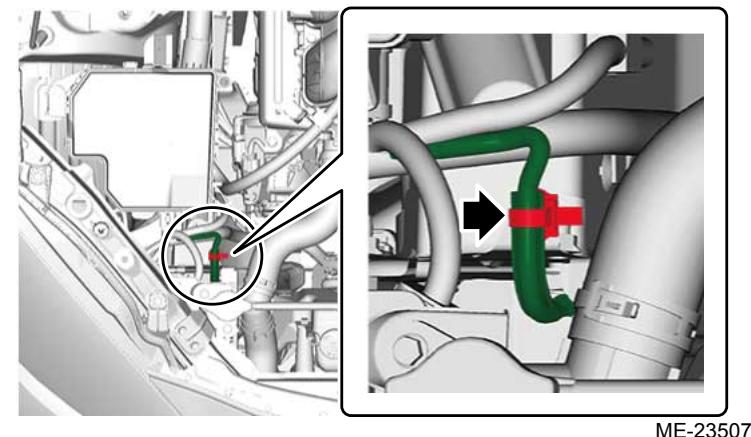
(10) Remove the clip securing the bulkhead wiring harness to the vehicle.

Note:

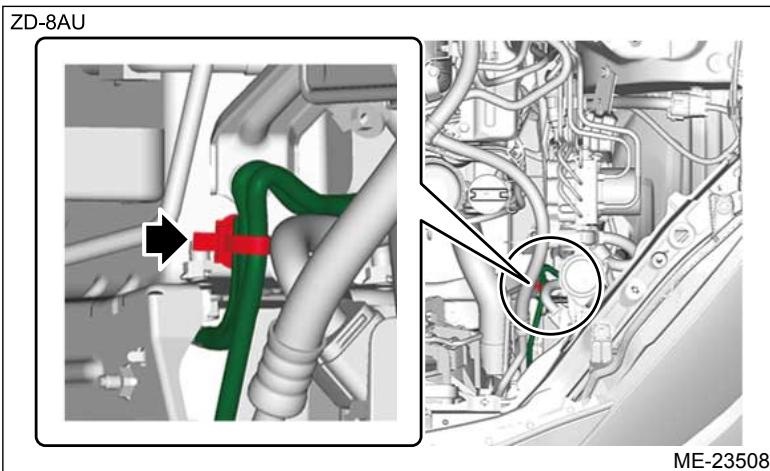
This procedure is required to prevent the bulkhead wiring harness from being damaged by the adjuster (ST).

- RH side

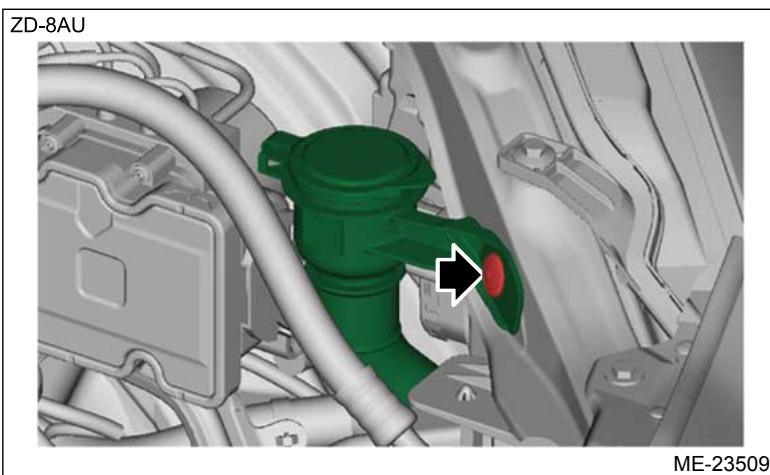
ZD-8AU



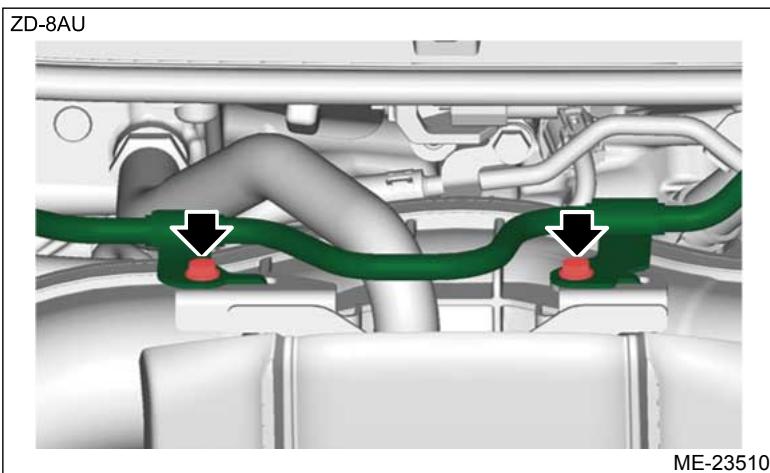
- LH side



(11) Remove the clip securing the hose inlet assembly to the vehicle.

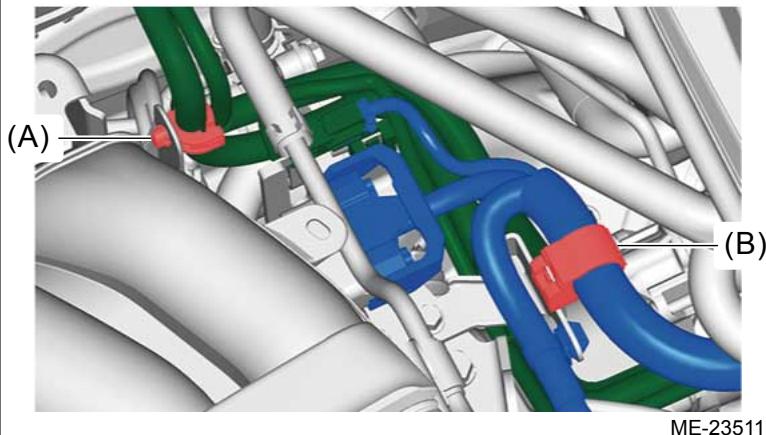


(12) Remove the bolts which secure the brake vacuum pipe to the collector cover bracket No. 2.



(13) Remove the clip (A) which secures the battery cable assembly to the intake manifold assembly, and remove the clip (B) which secures the bulkhead wiring harness to the engine rear hanger.

ZD-8AU



(14) Lift the engine using ST1, ST2, ST3, ST4 and the shackle, and install ST5.

1) Using the ST1, install the ST2 to the engine unit.

Preparation tool:

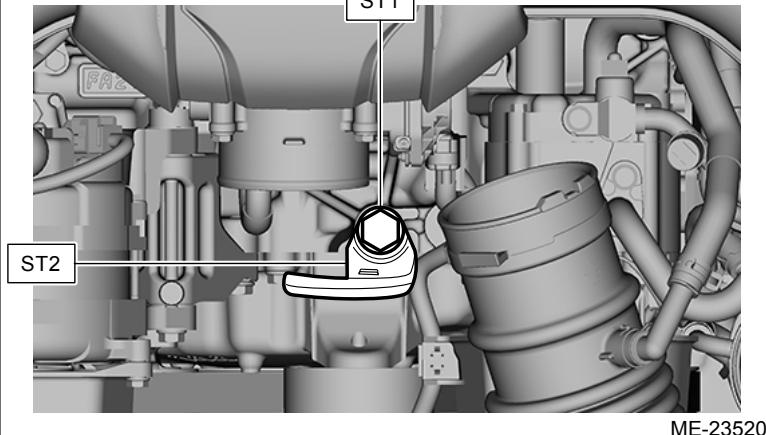
ST1: BOLT (90119-14120)

ST2: ENGINE HANGER NO.1 (12281-38150)

Tightening torque:

43 N·m (4.4 kgf-m, 31.7 ft-lb)

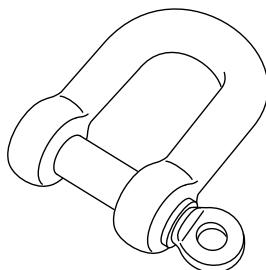
ZD-8AU



1) Set the ST3, ST4, and the shackle to the vehicle.

Caution:

- Use a shackle with the load capacity of 250 kg (551 lb) or more.



FS-00325

- Set the ST3, ST4, and the shackle at the locations shown in the figure.

Preparation tool:

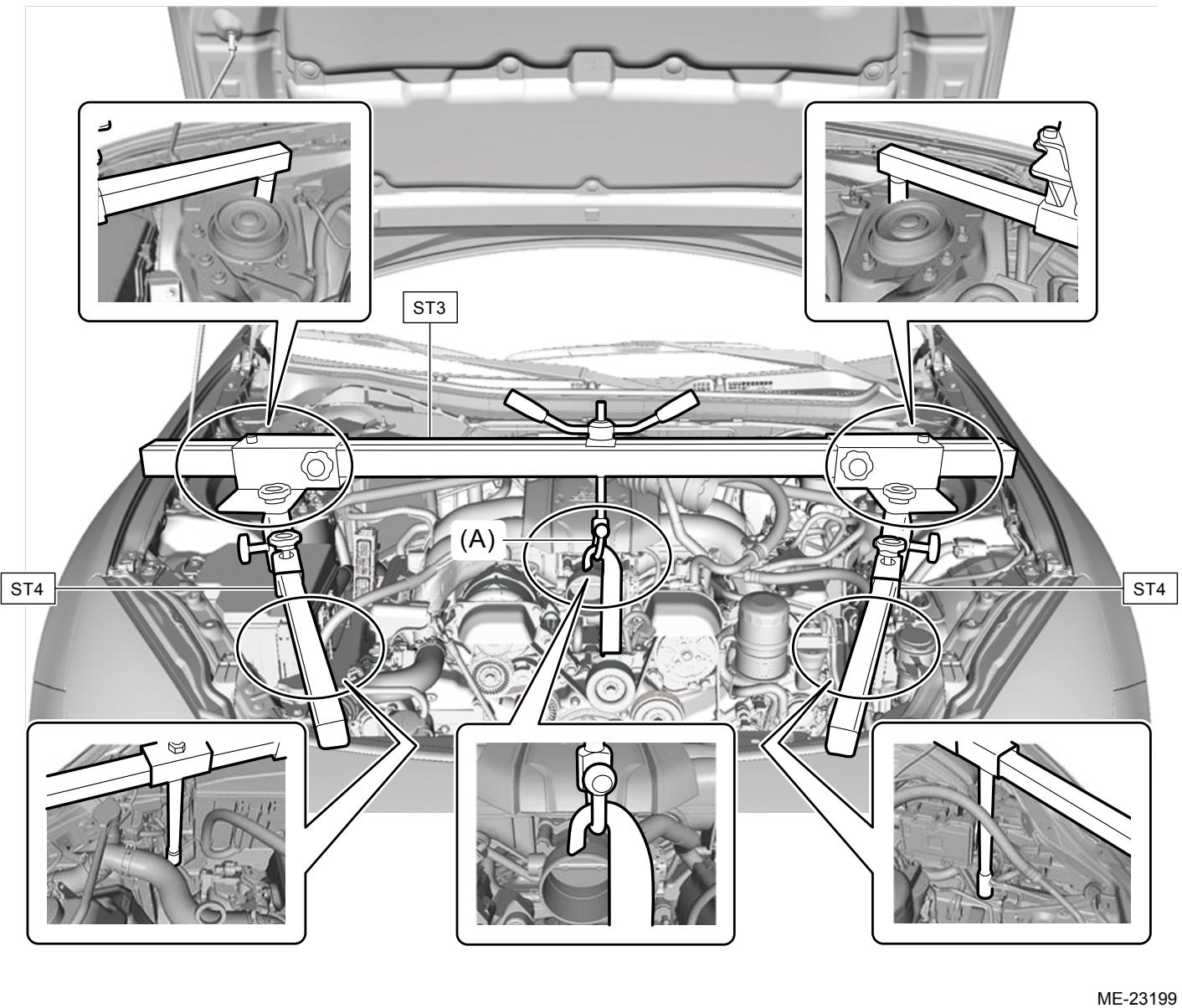
ST3: ENGINE HANGER (99099AJ000)

ST4: ADJUSTER (18679AA020)

General tool:

Shackle

ZD-8AU



ME-23199

(A) Shackle

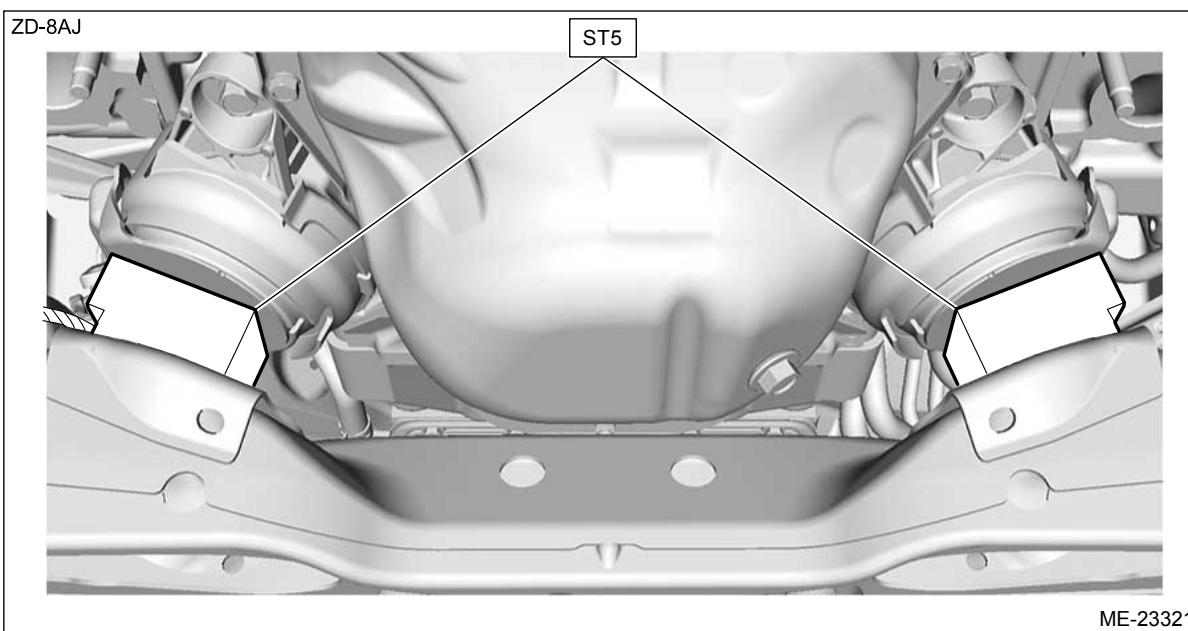
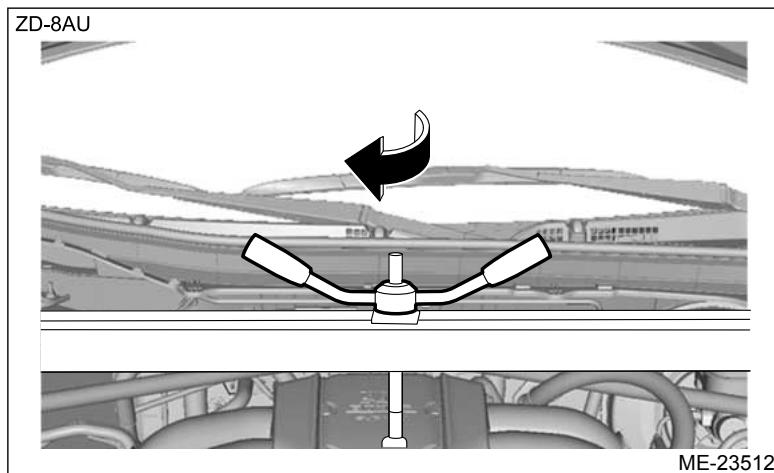
- 2) Turn the handle clockwise to lift the engine gradually and set the ST5 between the engine mounting and crossmember COMPL front.

Caution:

- To prevent damage to the threaded portion of the handle, apply grease or lubricants to the threaded portion before starting the work.
- When lifting up the engine unit, pay attention to the clearance of each part and be careful not to lift the engine too much, in order to prevent damaging the vehicle.
- When the engine unit is lifted, #4 part of the intake manifold assembly and hose pressure suction contact lightly. Insert a cloth, etc. between #4 part of the intake manifold assembly and hose pressure suction for protection.

Preparation tool:

ST5: STAND ASSY (18632AA020)

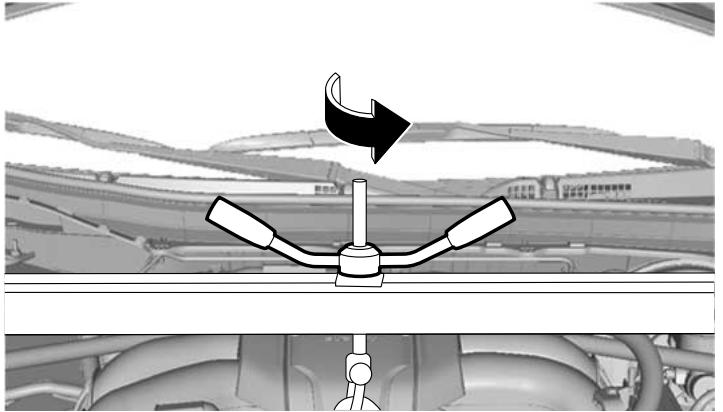


- 3) Turn the handle counterclockwise to lower the engine gradually and remove ST3, ST4 and the shackle.

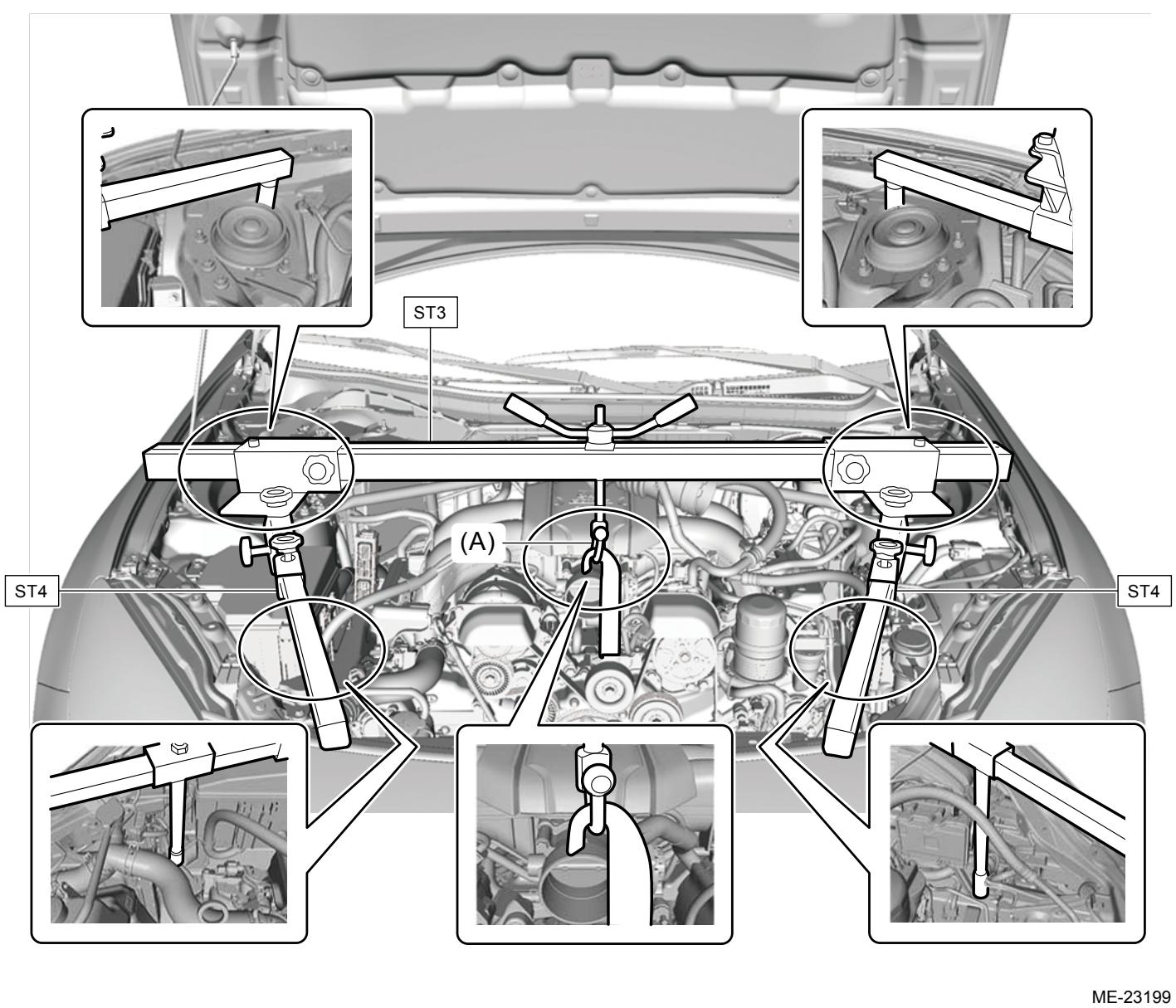
Caution:

After lowering the engine, rock the engine to check that the ST5 does not come off.

ZD-8AU



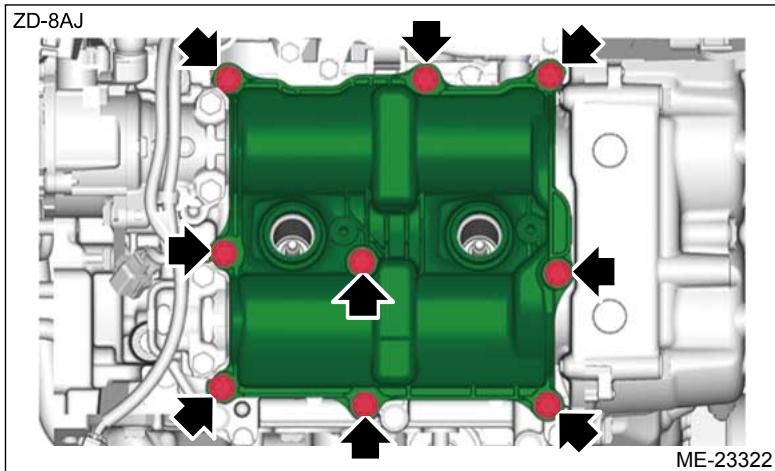
ZD-8AU



(A) Shackle

- (15) Remove the strut tower bar RH. [Ref. to FRONT SUSPENSION>Strut Tower Bar>REMOVAL.](#)
 (16) Remove the fuel pipe protector RH No. 2. [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>Fuel Pipe Protector>REMOVAL>FUEL PIPE PROTECTOR RH >FUEL PIPE PROTECTOR RH NO. 2.](#)

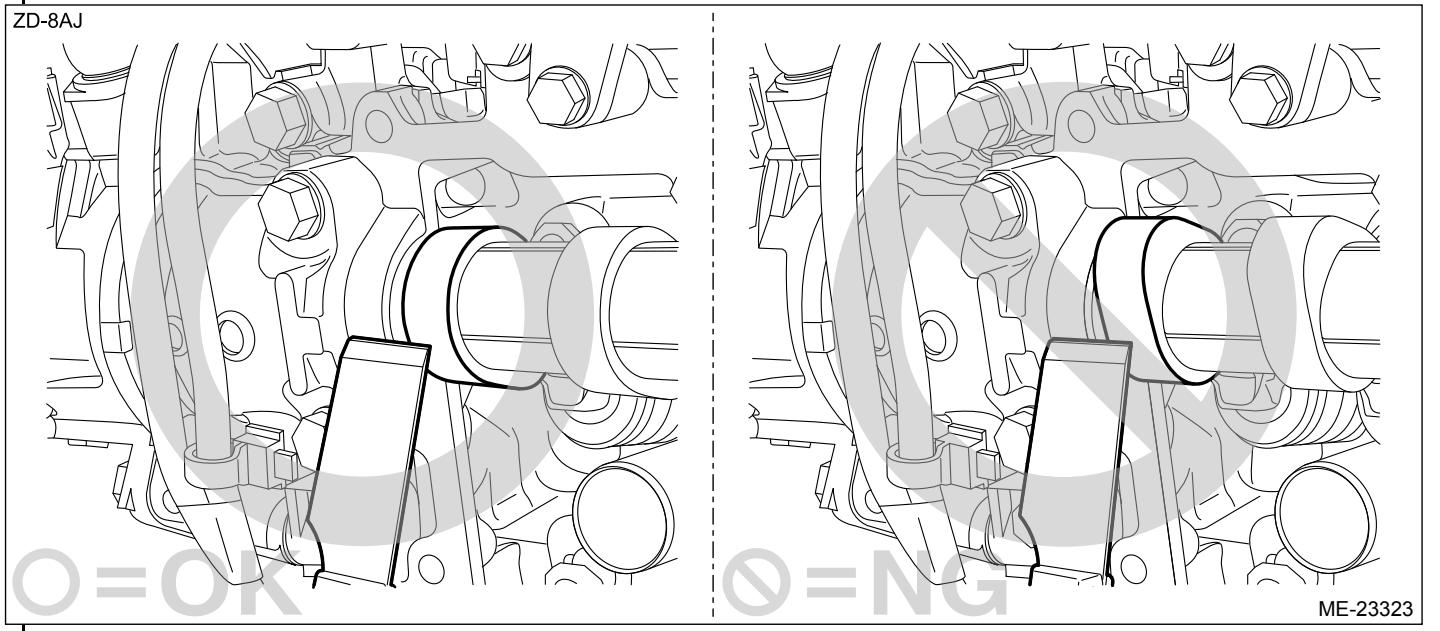
2. Remove the #1 ignition coil and the #3 ignition coil. [Ref. to IGNITION\(H4DO\)>Ignition Coil>REMOVAL > RH SIDE.](#)
3. Remove the rocker cover RH.

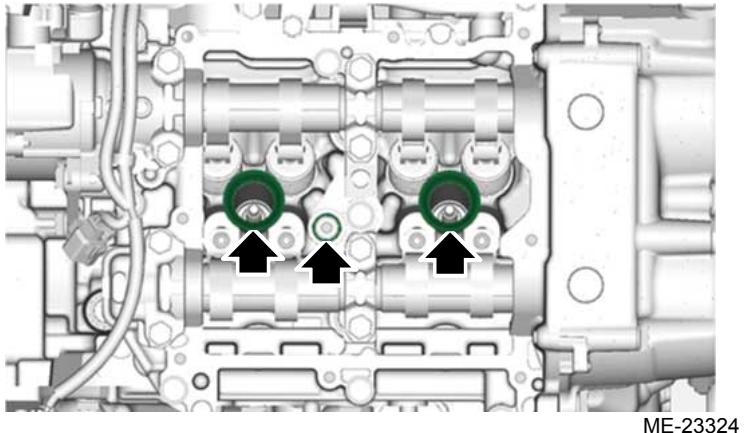


4. Remove the rocker cover gasket (ring type) and the spark plug pipe gasket, and remove the liquid gasket.

Caution:

- When removing the liquid gasket from engine unit using scraper, use special care not to damage the cam lobe of camshaft RH.
- If the cam lobe of camshaft RH interferes, turn the crankshaft to the position where the scraper does not touch.





5. Remove the rocker cover gasket RH from the rocker cover RH, and remove the liquid gasket.

2. ROCKER COVER LH

Note:

When replacing a single part, perform the work with the engine assembly installed to body.

1. When working on the vehicle

Note:

When working on the vehicle, perform the following steps also.

- (1) Fully open the panel COMPL front hood. [Ref. to REPAIR CONTENTS>NOTE > STAY ASSEMBLY FRONT HOOD.](#)
- (2) Disconnect the ground terminal of battery sensor. [Ref. to REPAIR CONTENTS>NOTE > BATTERY.](#)
- (3) Perform the steps below to remove the air intake boot, and place it aside so that it does not interfere with the work.

Caution:

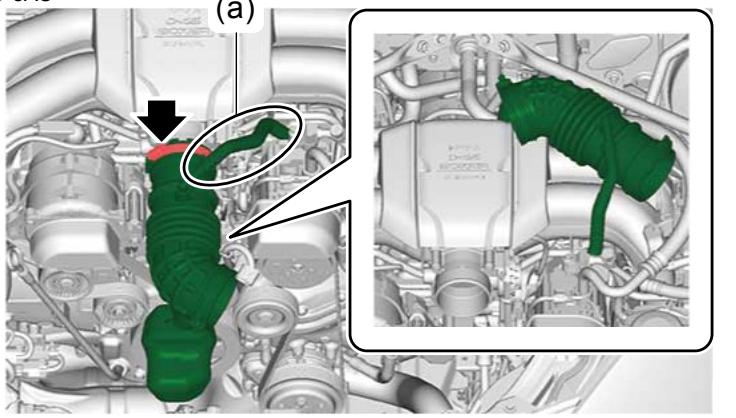
Do not remove the PCV hose No. 2 (a).

- 1) Remove the air cleaner case. [Ref. to INTAKE_\(INDUCTION\)\(H4DO\)>Air Cleaner Case>REMOVAL.](#)
- 2) Loosen the clamp, remove the air intake boot, and place it aside so that it does not interfere with the work.

Caution:

Be careful not to pull out the PCV hose No. 2 (a).

ZD-8AU



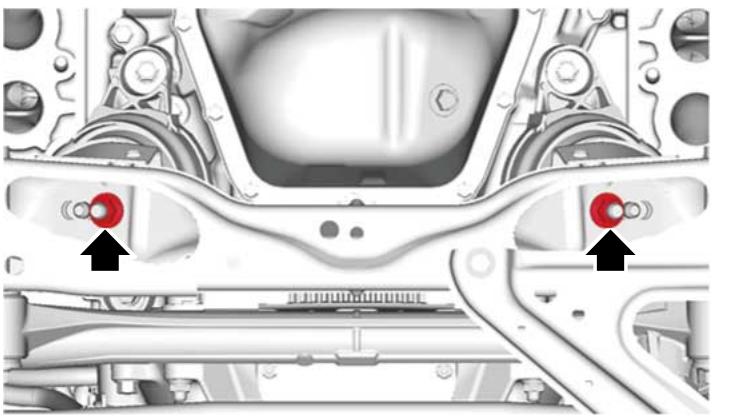
IN-10776

(4) Remove the ECM. [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>Engine Control Module \(ECM\)>REMOVAL.](#)

(5) Remove the front exhaust pipe. [Ref. to EXHAUST\(H4DO\)>Front Exhaust Pipe>REMOVAL.](#)

(6) Remove the nuts which secure the engine mounting to the crossmember COMPL front.

ZD-8AU



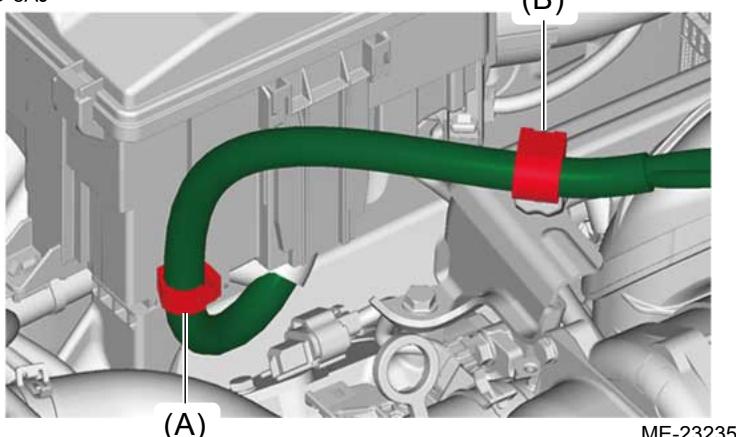
ME-23506

(7) Lower the vehicle.

(8) Open the claw of the clip (A) which secures the generator cord to the main fuse box and remove the generator cord.

(9) Remove the clip (B) securing the generator cord to the fuel pipe protector RH No. 1.

ZD-8AJ



ME-23235

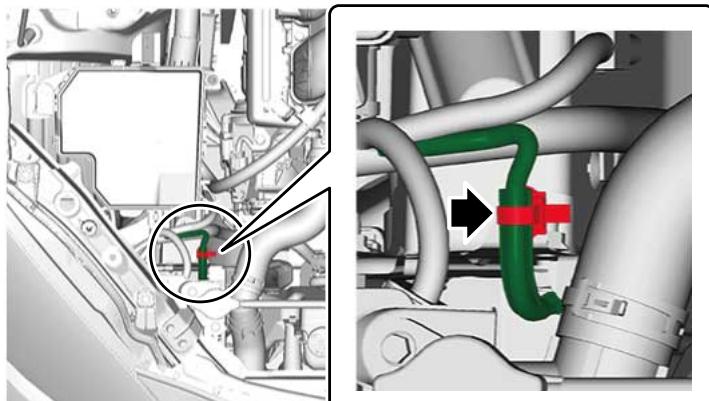
(10) Remove the clip securing the bulkhead wiring harness to the vehicle.

Note:

This procedure is required to prevent the bulkhead wiring harness from being damaged by the adjuster (ST).

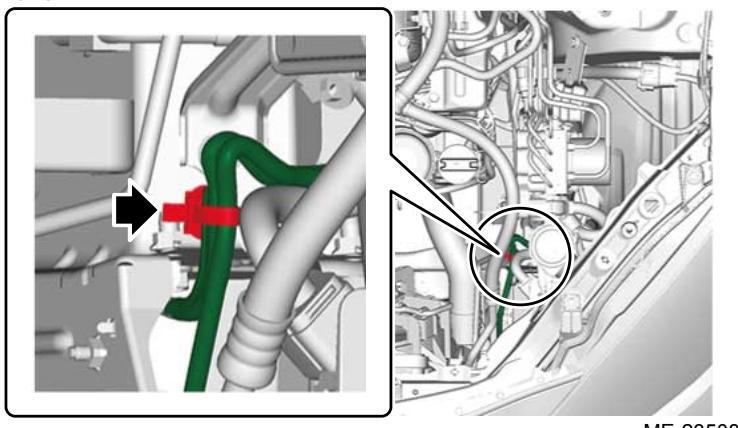
- RH side

ZD-8AU



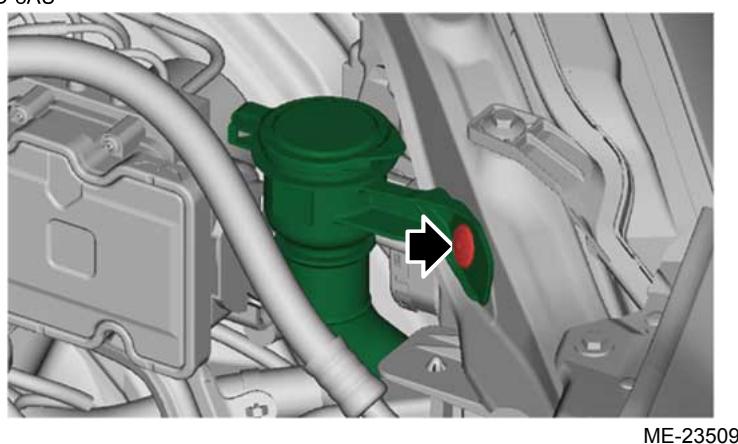
- LH side

ZD-8AU



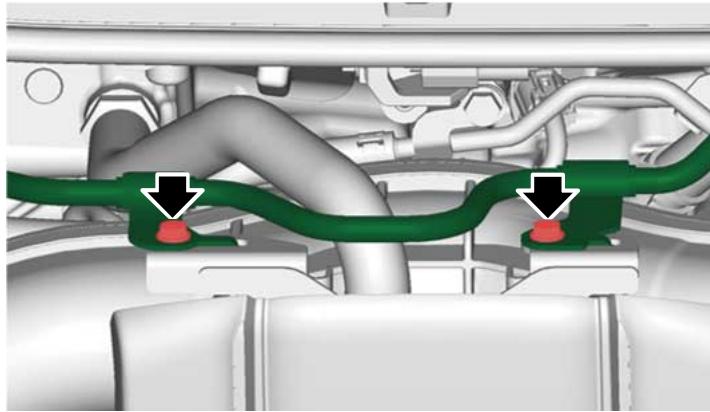
(11) Remove the clip securing the hose inlet assembly to the vehicle.

ZD-8AU



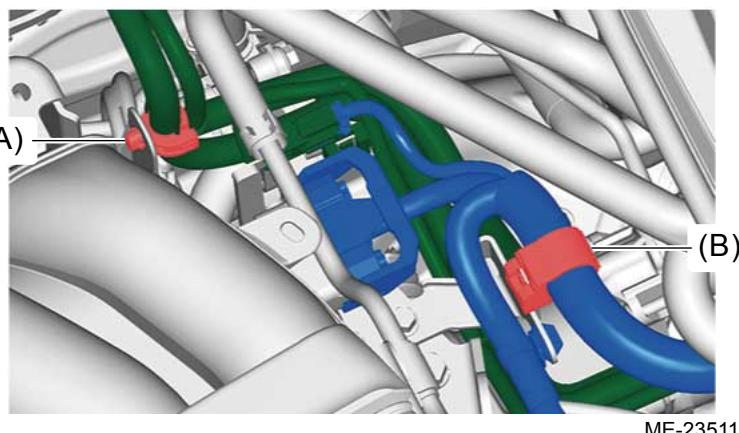
(12) Remove the bolts which secure the brake vacuum pipe to the collector cover bracket No. 2.

ZD-8AU



(13) Remove the clip (A) which secures the battery cable assembly to the intake manifold assembly, and remove the clip (B) which secures the bulkhead wiring harness to the engine rear hanger.

ZD-8AU



(14) Lift the engine using ST1, ST2, ST3, ST4 and the shackle, and install ST5.

1) Using the ST1, install the ST2 to the engine unit.

Preparation tool:

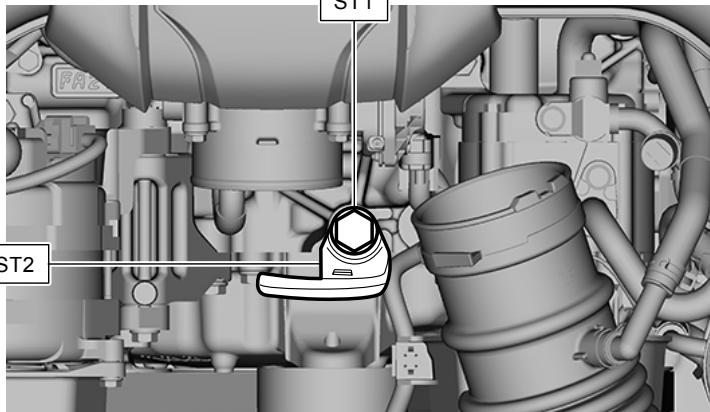
ST1: BOLT (90119-14120)

ST2: ENGINE HANGER NO.1 (12281-38150)

Tightening torque:

43 N·m (4.4 kgf-m, 31.7 ft-lb)

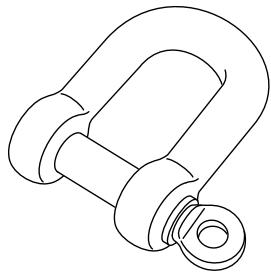
ZD-8AU



1) Set the ST3, ST4, and the shackle to the vehicle.

Caution:

- Use a shackle with the load capacity of 250 kg (551 lb) or more.



FS-00325

- Set the ST3, ST4, and the shackle at the locations shown in the figure.

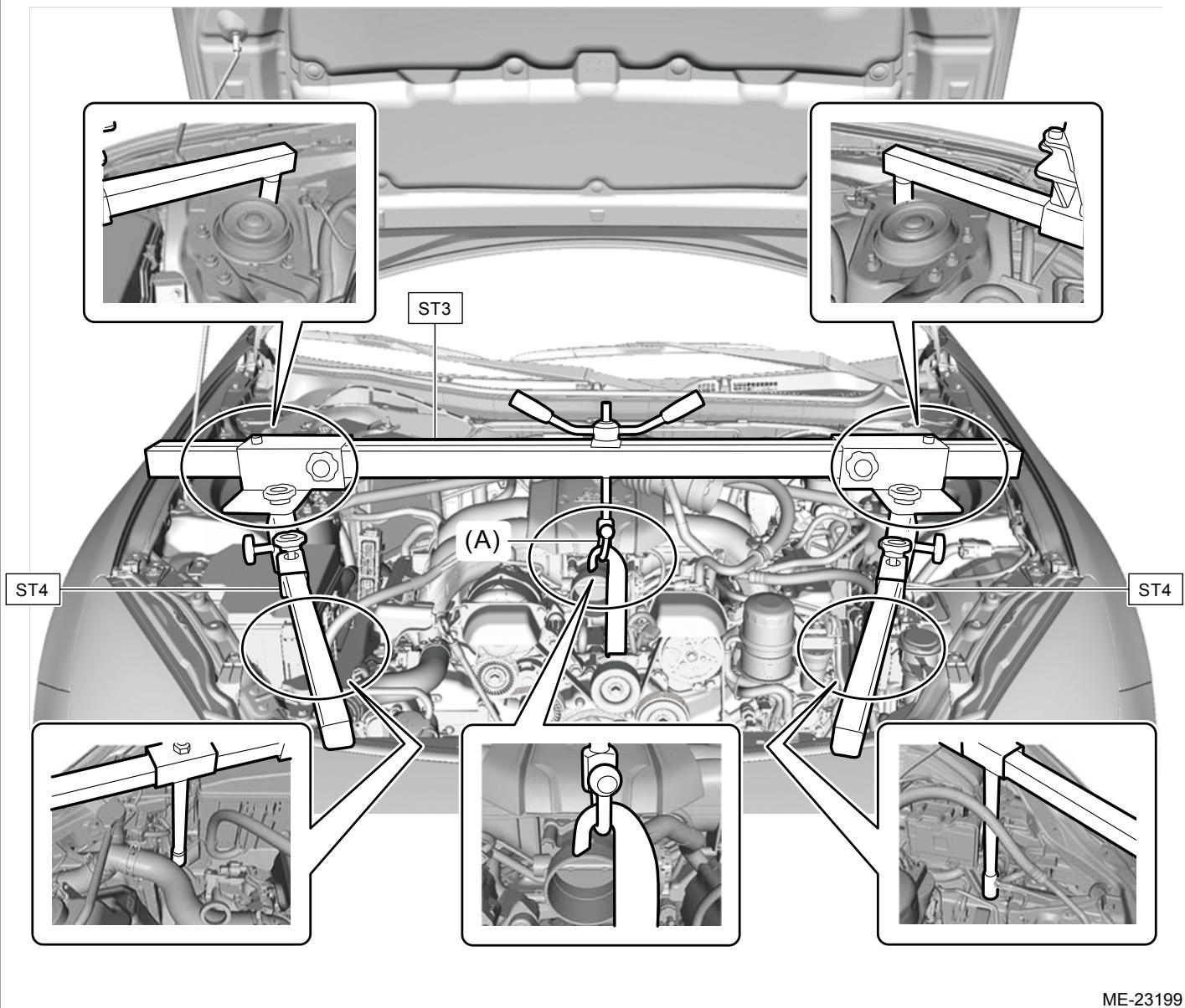
Preparation tool:

ST3: ENGINE HANGER (99099AJ000)

ST4: ADJUSTER (18679AA020)

General tool:

Shackle



ME-23199

(A) Shackle

2) Turn the handle clockwise to lift the engine gradually and set the ST5 between the engine mounting and crossmember COMPL front.

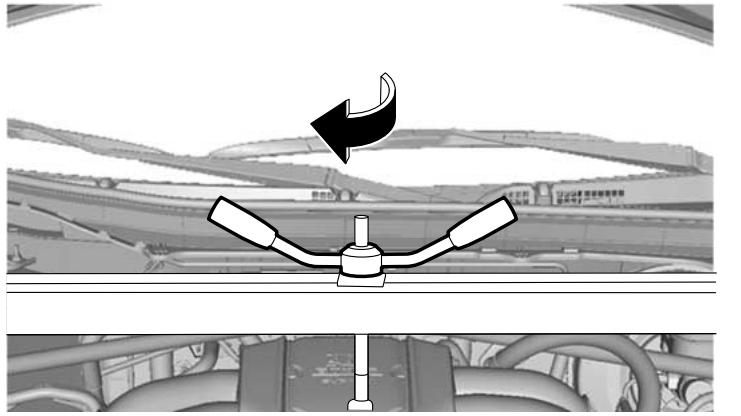
Caution:

- To prevent damage to the threaded portion of the handle, apply grease or lubricants to the threaded portion before starting the work.
- When lifting up the engine unit, pay attention to the clearance of each part and be careful not to lift the engine too much, in order to prevent damaging the vehicle.
- When the engine unit is lifted, #4 part of the intake manifold assembly and hose pressure suction contact lightly. Insert a cloth, etc. between #4 part of the intake manifold assembly and hose pressure suction for protection.

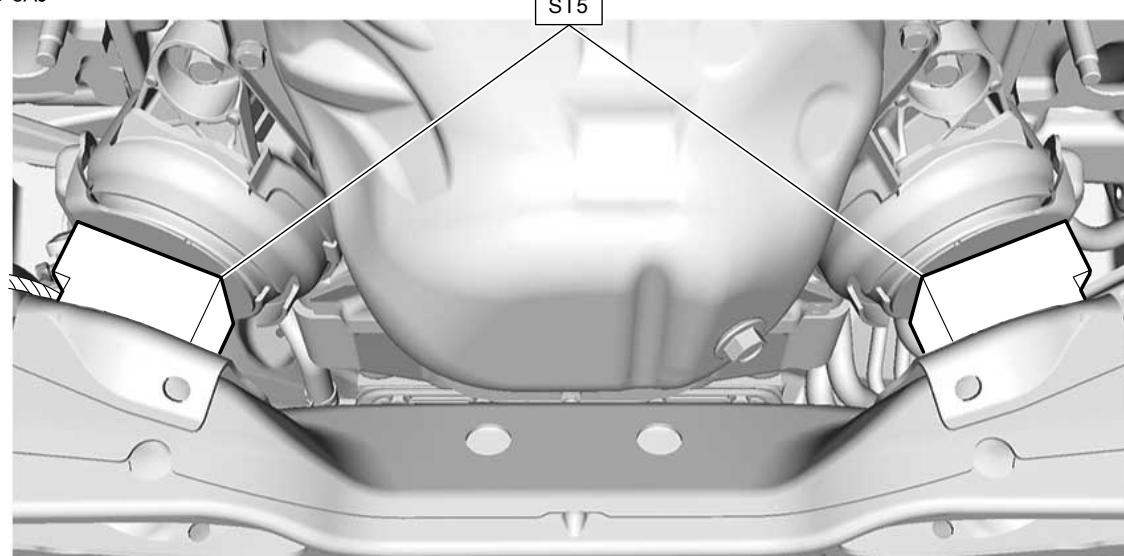
Preparation tool:

ST5: STAND ASSY (18632AA020)

ZD-8AU



ZD-8AJ

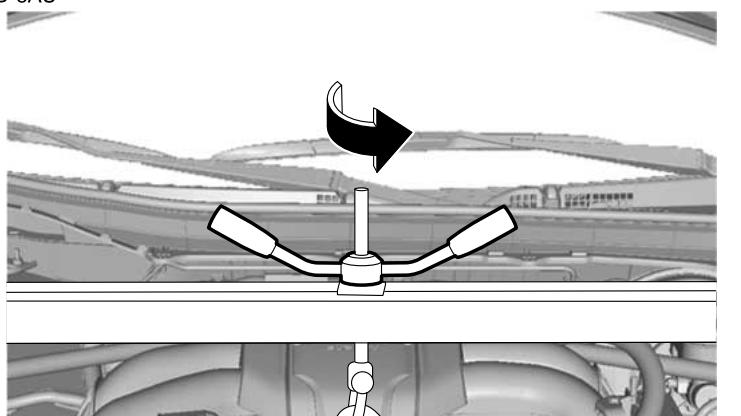


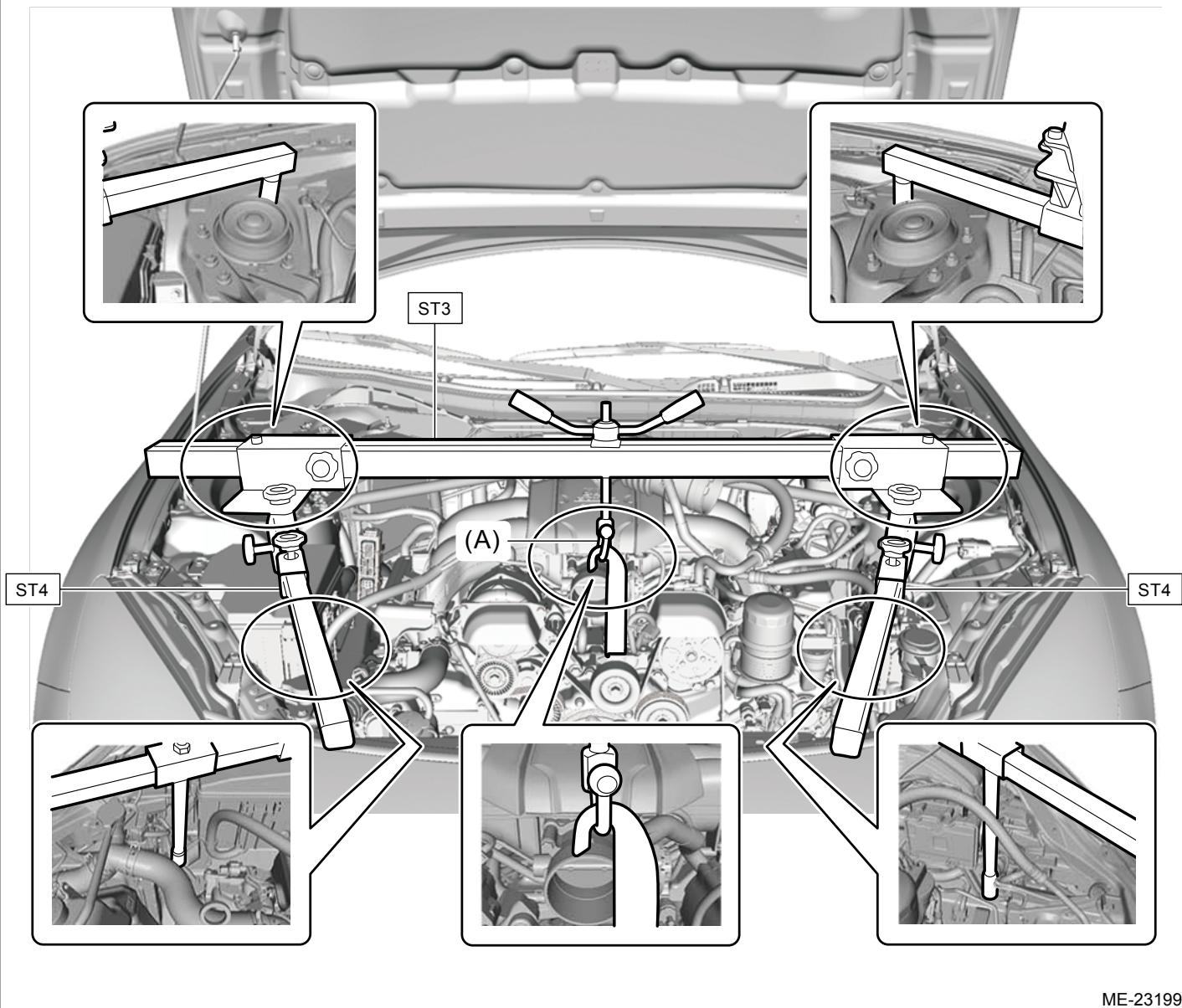
- 3) Turn the handle counterclockwise to lower the engine gradually and remove ST3, ST4 and the shackle.

Caution:

After lowering the engine, rock the engine to check that the ST5 does not come off.

ZD-8AU





ME-23199

(A) Shackle

(15) Disconnect the fuel delivery tube and evaporation hose.

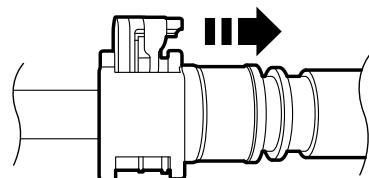
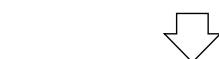
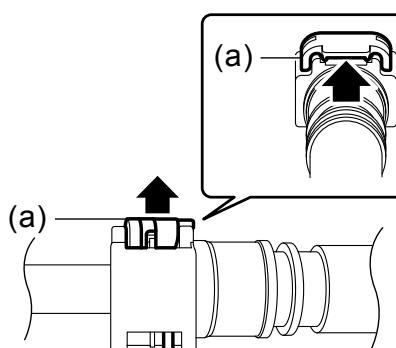
Caution:

- Be careful not to spill fuel.
- Catch the fuel from the tubes using a container or cloth.

- 1) Disconnect the evaporation hose (A) from the vacuum pipe.
- 2) Open the claw (B) on the fuel delivery tube clamp.
- 3) Disconnect the quick connector on the fuel delivery tube (cylinder direct injection side) (C) from the fuel delivery pipe assembly, and disconnect the quick connector on the fuel delivery tube (port injection side) (D) from the fuel pipe LH.

Note:

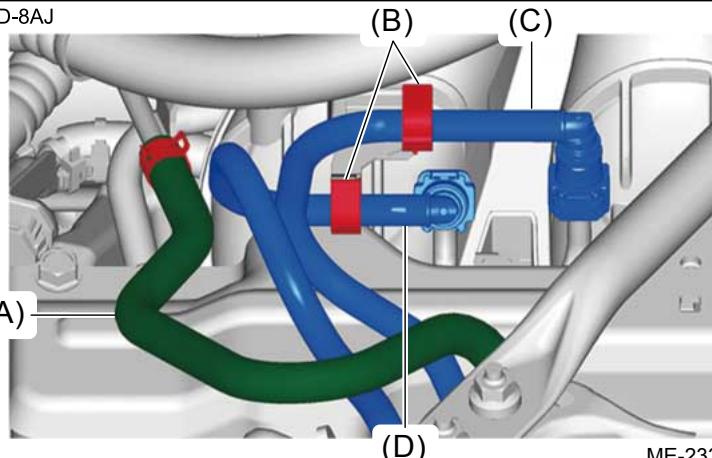
Disconnect the quick connector as shown in the figure.



ME-22794

(a) Slider

ZD-8AJ



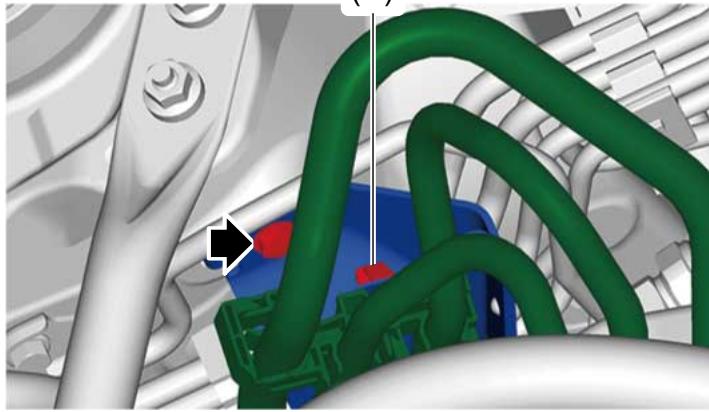
ME-23325

(16) Remove the claw (A) securing the fuel delivery tube clamp to the fuel protector, and place the fuel delivery tube clamp together with the tubes aside so that they do not interfere with work.

(17) Remove the fuel protector.

ZD-8AJ

(A)

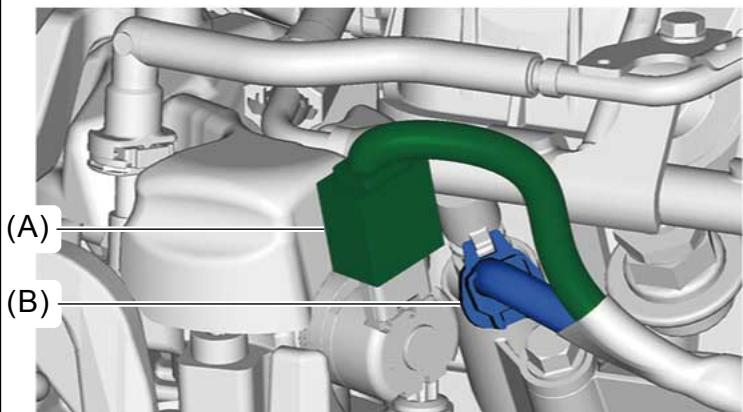


ME-23326

(18) Remove the strut tower bar LH. [Ref. to FRONT SUSPENSION>Strut Tower Bar>REMOVAL.](#)

2. Remove the #2 ignition coil and the #4 ignition coil. [Ref. to IGNITION\(H4DO\)>Ignition Coil>REMOVAL > LH SIDE.](#)
3. Remove the fuel pipe protector LH No. 1. [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>Fuel Pipe Protector>REMOVAL>FUEL PIPE PROTECTOR LH>FUEL PIPE PROTECTOR LH NO. 1.](#)
4. Disconnect the connector (A) from the high-pressure fuel pump, and disconnect the connector (B) from the #2 fuel injector (port injection side).

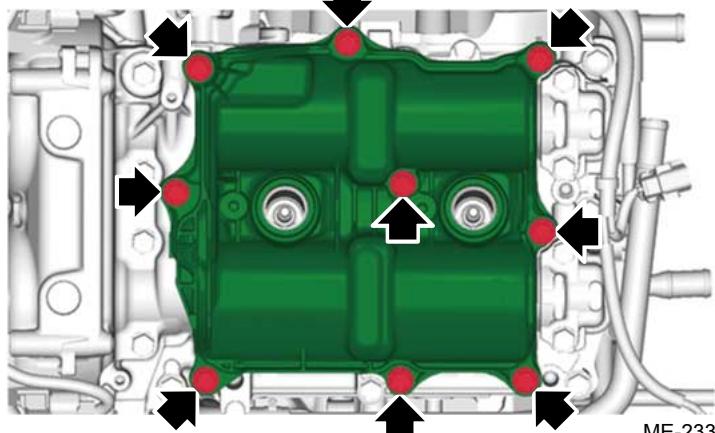
ZD-8AJ



ME-23327

5. Remove the rocker cover LH.

ZD-8AJ



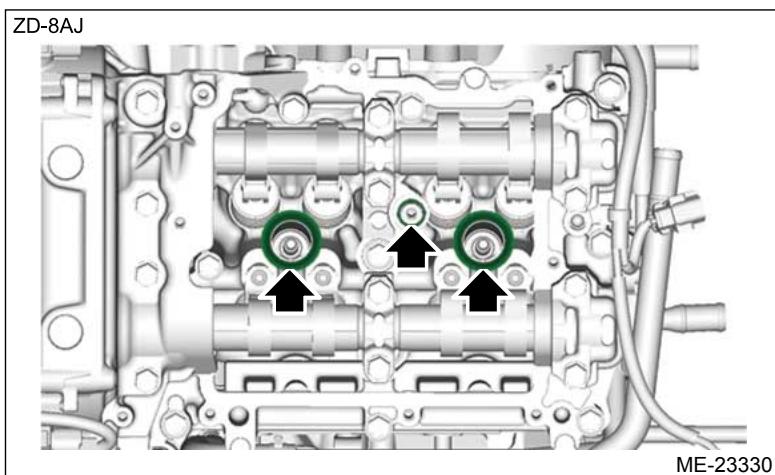
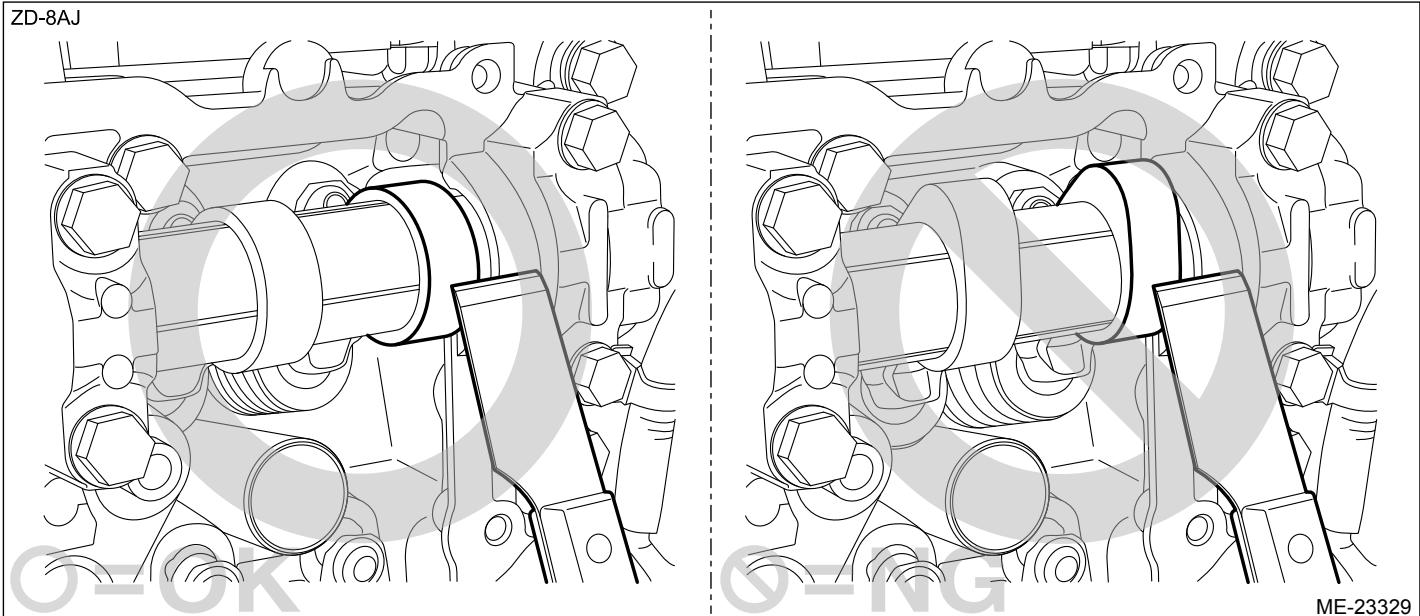
ME-23328

6. Remove the rocker cover gasket (ring type) and the spark plug pipe gasket, and remove the liquid

gasket.

Caution:

- When removing the liquid gasket from engine unit using scraper, use special care not to damage the cam lobe of camshaft LH.
- If the cam lobe of camshaft LH interferes, turn the crankshaft to the position where the scraper does not touch.



7. Remove the rocker cover gasket LH from the rocker cover LH, and remove the liquid gasket.

MECHANICAL(H4DO) > Rocker Cover

INSTALLATION

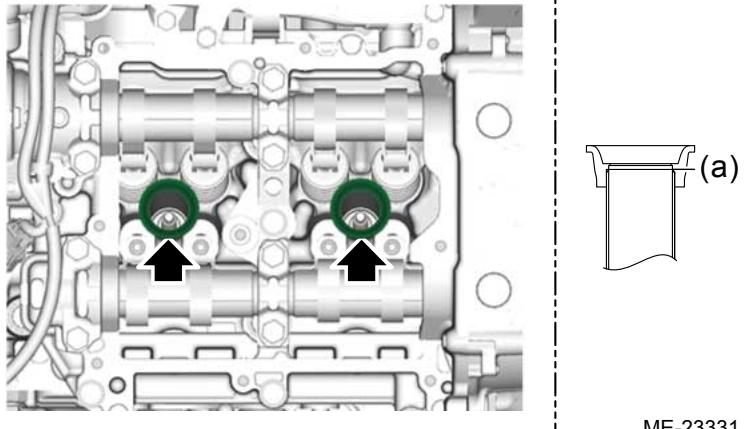
1. ROCKER COVER RH

1. Install new spark plug pipe gaskets to the spark plug pipe.

Note:

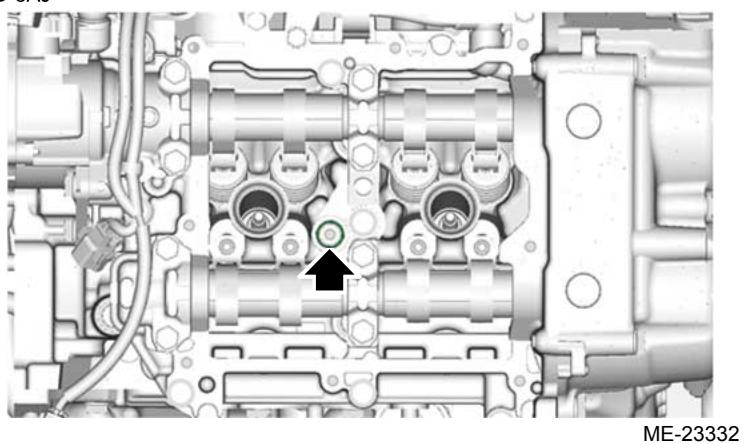
Apply a light coat of engine oil to the spark plug pipe gaskets, and insert them onto the spark plug pipe edge (a).

ZD-8AJ



- 2.** Install new rocker cover gasket (ring type) to the cam carrier RH.

ZD-8AJ

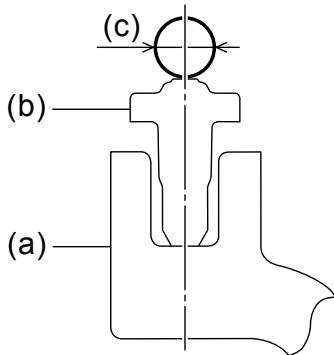


- 3.** Install new rocker cover gasket RH to the rocker cover RH.
- 4.** Apply liquid gasket to the mating surface of rocker cover RH as shown in the figure.

Note:

- Before applying liquid gasket, degrease the old liquid gasket seal surface of the engine.
- Apply liquid gasket to the center of rocker cover gasket and be careful not to allow liquid gasket to be squeezed out from rocker cover gasket.

SK-5CJ



ME-22889

(a) Rocker cover

(b) Rocker cover gasket

(c) $\phi 3 \pm 1$ mm
(0.1181 ± 0.0394 in)

- Install within 5 min. after applying liquid gasket.

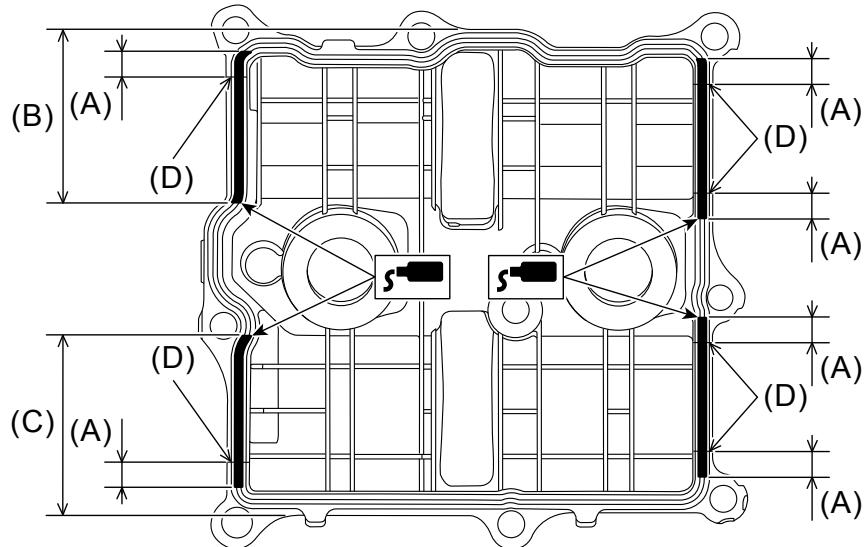
Preparation items:

Liquid gasket: THREE BOND 1217G (part No. K0877Y0100), THREE BOND 1217H or equivalent

Liquid gasket applying diameter:

3 ± 1 mm (0.1181 ± 0.0394 in)

VB-HBU



ME-23787

(A) 10 mm (0.3937 in) or more (C) 65.5 — 67.5 mm (2.5787 — 2.6575 in) (D) Arch starting point

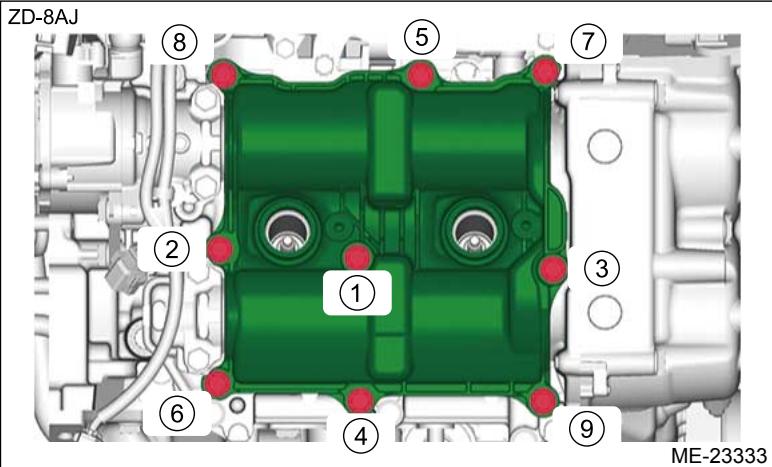
(B) 70.3 mm (2.7677 in) or more

5. Install the rocker cover RH to the cam carrier RH.

- (1) Set the rocker cover RH on the cam carrier RH, and fasten all bolts until their two or more full threads engage.
- (2) Tighten all bolts with a torque of 6.4 N·m (0.7 kgf-m, 4.7 ft-lb) in numerical order as shown in the figure.
- (3) Tighten all bolts again with a torque of 6.4 N·m (0.7 kgf-m, 4.7 ft-lb) in numerical order as shown in the figure.

Note:

This procedure is necessary to stabilize torque.



6. Install the #1 ignition coil and the #3 ignition coil. [Ref. to IGNITION\(H4DO\)>Ignition Coil>REMOVAL > RH SIDE.](#)
7. When working on the vehicle

Note:

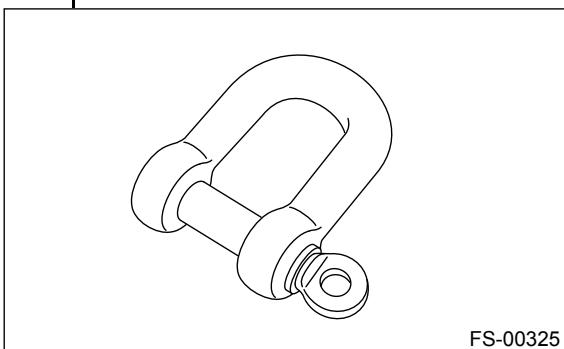
When working on the vehicle, perform the following steps also.

- (1) Install the fuel pipe protector RH No. 2. [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>Fuel Pipe Protector>INSTALLATION>FUEL PIPE PROTECTOR RH >FUEL PIPE PROTECTOR RH NO. 2.](#)
- (2) Install the strut tower bar RH. [Ref. to FRONT SUSPENSION>Strut Tower Bar>INSTALLATION.](#)
- (3) Lift the engine using ST1, ST2, ST3, ST4 and the shackle, and remove ST5.

- 1) Set the ST3, ST4, and the shackle to the vehicle.

Caution:

- Use a shackle with the load capacity of 250 kg (551 lb) or more.



FS-00325

- Set the ST3, ST4, and the shackle at the locations shown in the figure.

Preparation tool:

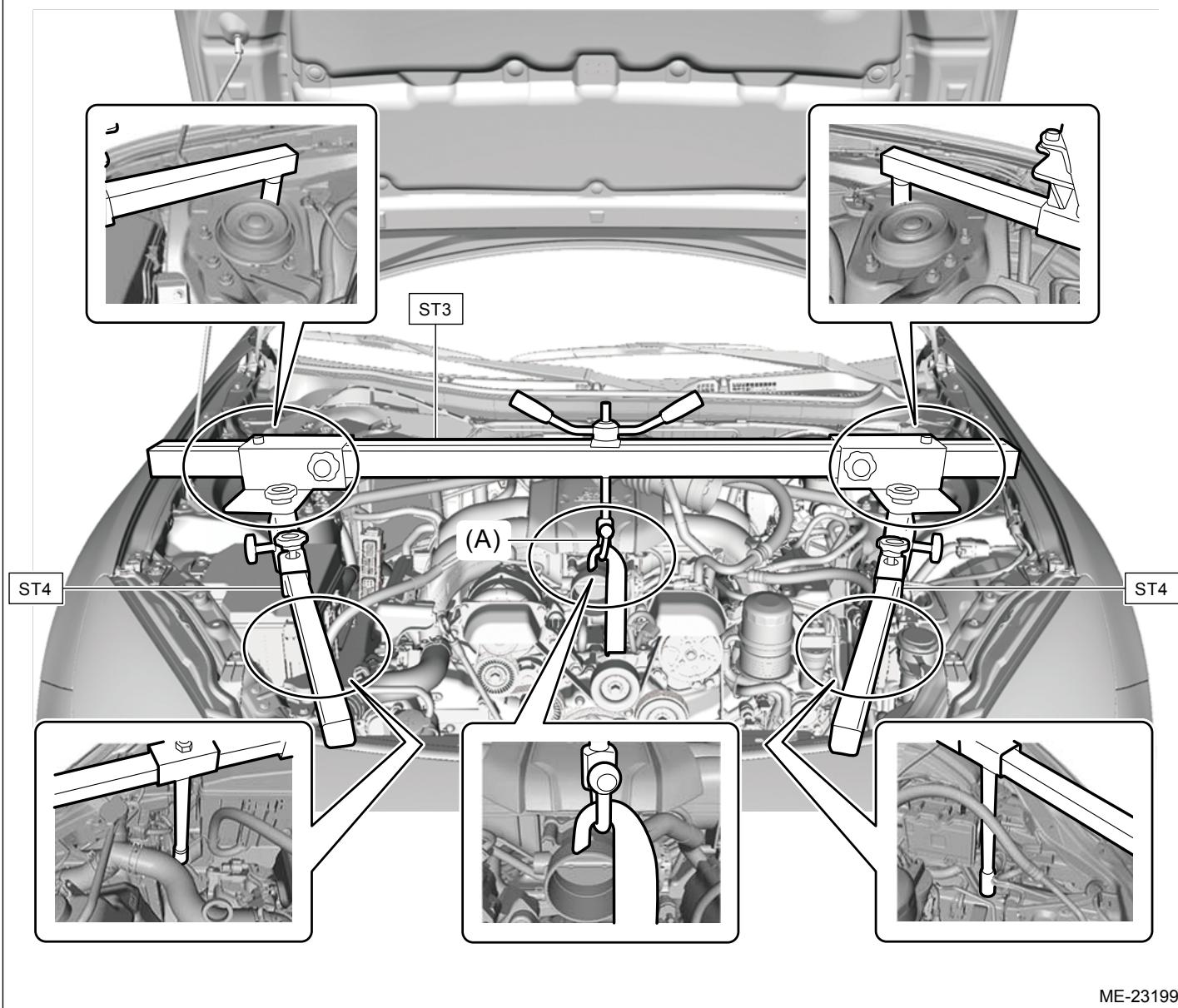
ST3: ENGINE HANGER (99099AJ000)

ST4: ADJUSTER (18679AA020)

General tool:

Shackle

ZD-8AU



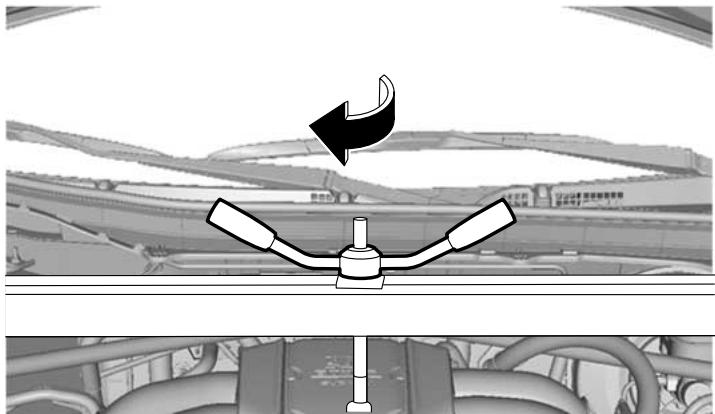
(A) Shackle

2) Turn the handle clockwise to lift the engine gradually and remove the ST5.

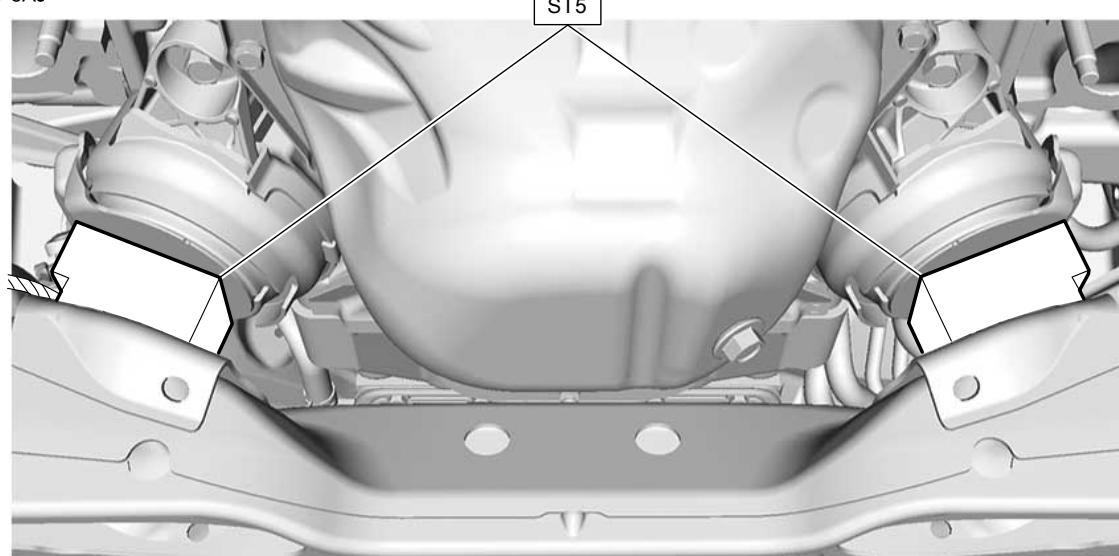
Caution:

- To prevent damage to the threaded portion of the handle, apply grease or lubricants to the threaded portion before starting the work.
- When lifting up the engine unit, pay attention to the clearance of each part and be careful not to lift the engine too much, in order to prevent damaging the vehicle.

ZD-8AU



ZD-8AJ



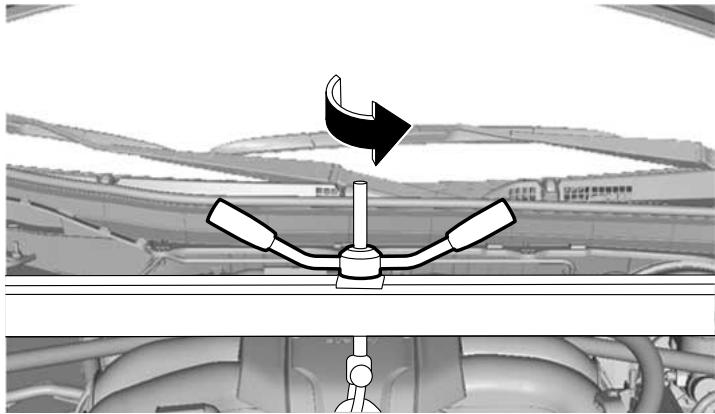
ME-23321

3) Turn the handle counterclockwise to lower the engine gradually and insert the stud bolt of the engine mounting into the engine mounting hole of the crossmember COMPL front.

Note:

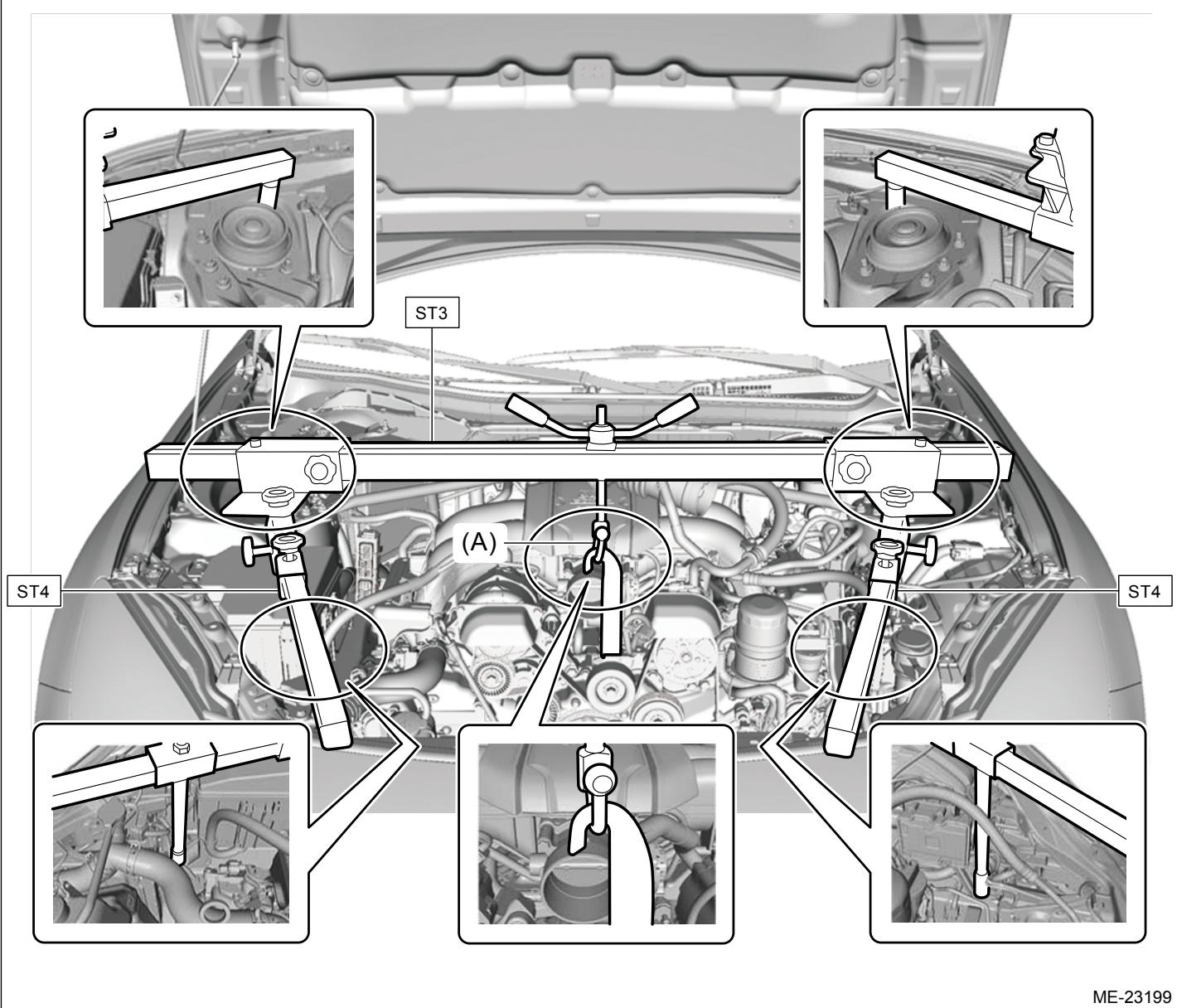
- If it is hard to insert the stud bolt of the engine mounting into the engine mounting hole of the crossmember COMPL front, lower the engine while lightly pushing it toward the rear of the vehicle.
- Check that the stud bolt of the engine mounting is securely inserted into the engine mounting hole of the crossmember COMPL front.

ZD-8AU



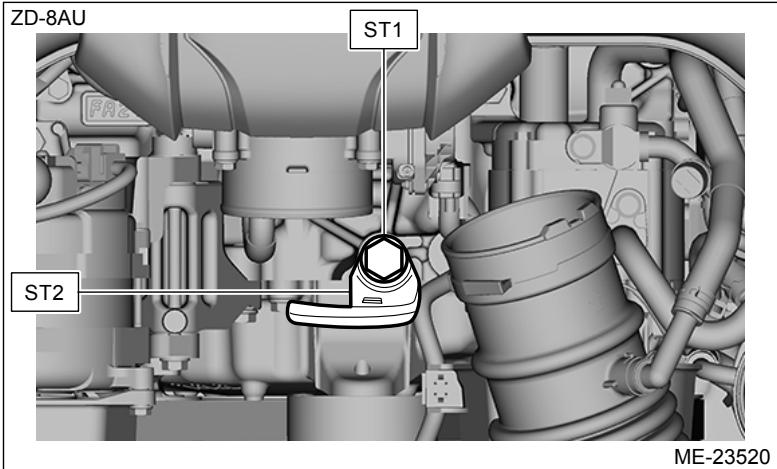
4) Remove ST3, ST4 and the shackle from the vehicle.

ZD-8AU

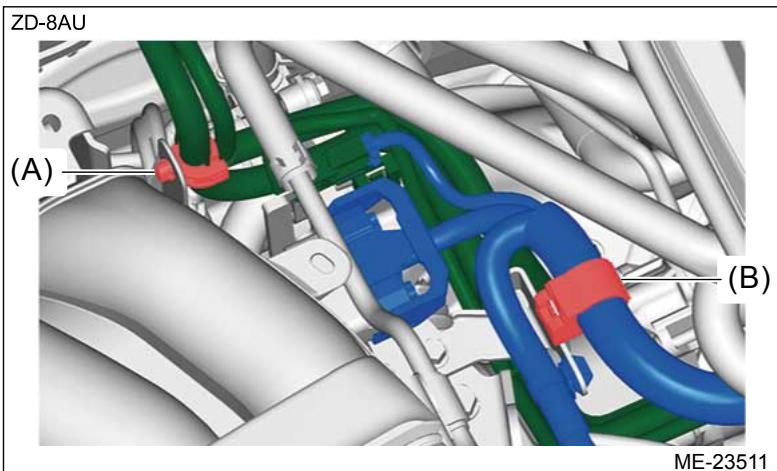


(A) Shackle

5) Remove the ST1 and ST2.



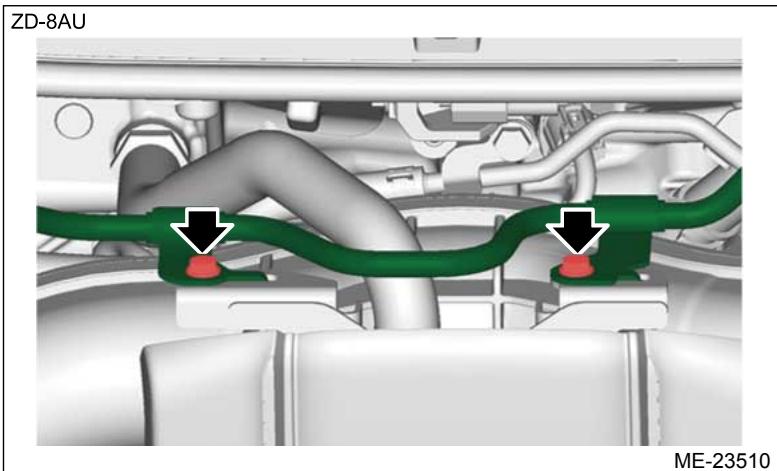
(4) Secure the bulkhead wiring harness to the engine rear hanger with clip (B), and secure the battery cable assembly to the intake manifold assembly with clip (A).



(5) Install the bolts which secure the brake vacuum pipe to the collector cover bracket No. 2.

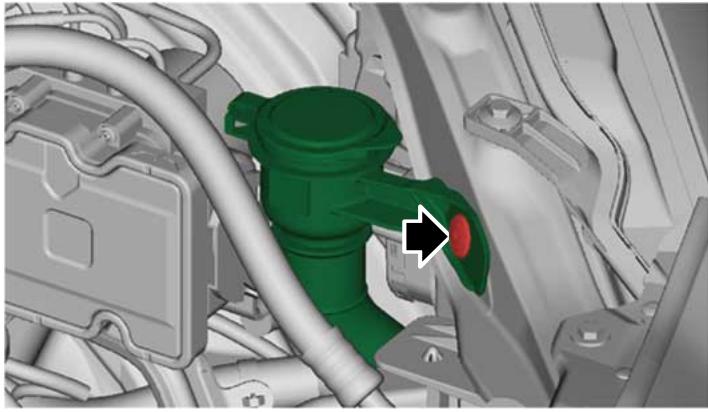
Tightening torque:

7.5 N·m (0.8 kgf·m, 5.5 ft-lb)



(6) Secure the hose inlet assembly to the vehicle with the clip.

ZD-8AU

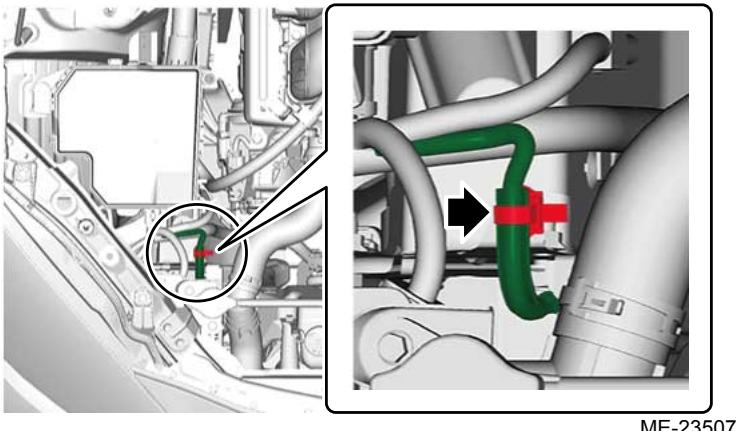


ME-23509

(7) Secure the bulkhead wiring harness to the vehicle with the clip.

- RH side

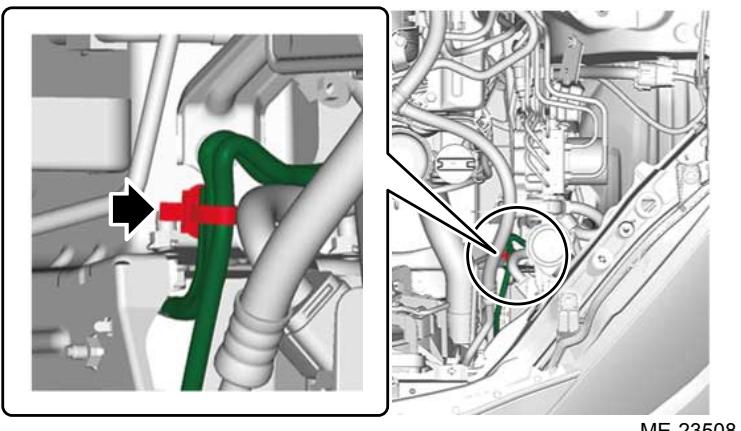
ZD-8AU



ME-23507

- LH side

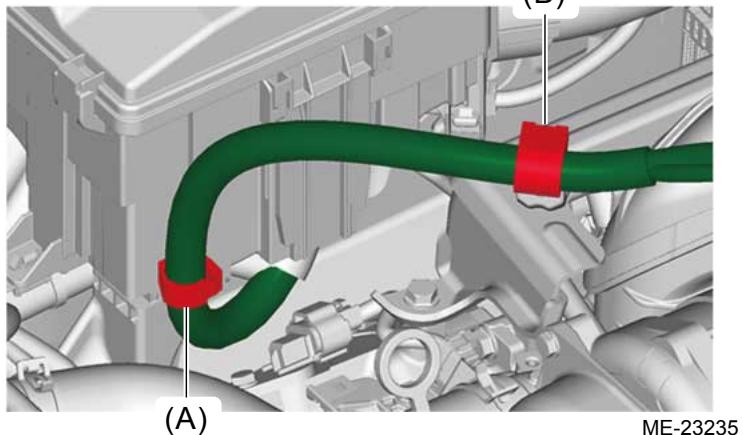
ZD-8AU



ME-23508

(8) Secure the generator cord to the fuel pipe protector RH No. 1 with clip (B), and secure the generator cord to the main fuse box with clip (A).

ZD-8AJ



(9) Lift up the vehicle.

(10) Install the nuts which hold the engine mounting to the crossmember COMPL front.

Caution:

Be sure to use a new nut.

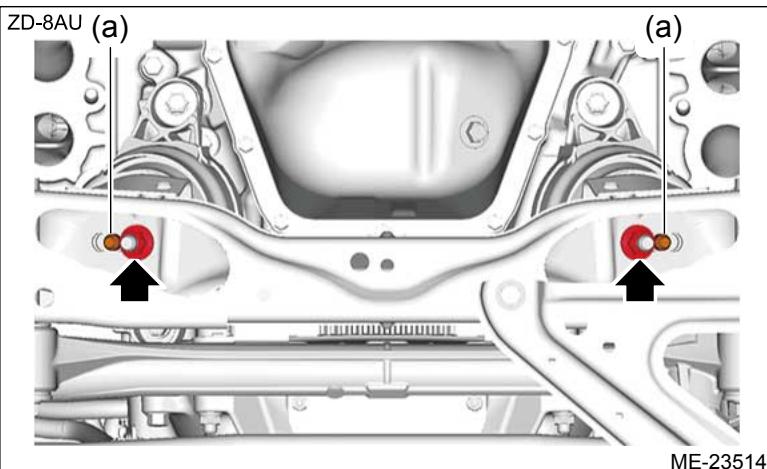
Note:

Make sure that locators (a) of the engine mounting are securely inserted.

Tightening torque:

90 N·m (9.2 kgf-m, 66.4 ft-lb)

ZD-8AU (a)



(11) Install the front exhaust pipe. [Ref. to EXHAUST\(H4DO\)>Front Exhaust Pipe>INSTALLATION.](#)

(12) Install the ECM. [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>Engine Control Module \(ECM\)>INSTALLATION.](#)

(13) Install the air intake boot. [Ref. to INTAKE \(INDUCTION\)\(H4DO\)>Air Intake Boot>INSTALLATION.](#)

(14) Connect the ground terminal to the battery sensor. [Ref. to REPAIR CONTENTS>NOTE > BATTERY.](#)

(15) Set the panel COMPL front hood to the normal position. [Ref. to REPAIR CONTENTS>NOTE > STAY ASSEMBLY FRONT HOOD.](#)

(16) Check the select lever and adjust it if necessary. (AT model)

Inspection:

[Ref. to CONTROL SYSTEMS>Select Lever>INSPECTION.](#)

Adjustment:

[Ref. to CONTROL SYSTEMS>Select Lever>ADJUSTMENT.](#)

Note:

This procedure is required because the select lever may be deviated from the adjusted position due to installation/removal of the nut on the engine mounting.

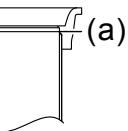
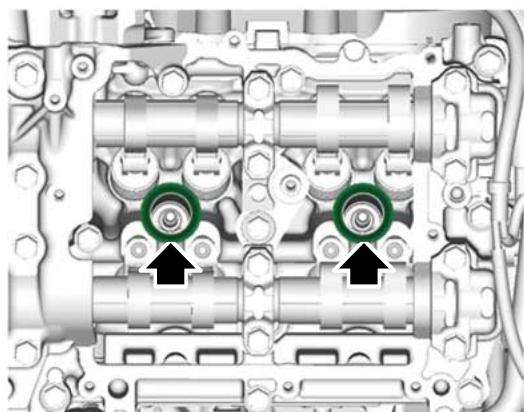
2. ROCKER COVER LH

1. Install new spark plug pipe gaskets to the spark plug pipe.

Note:

Apply a light coat of engine oil to the spark plug pipe gaskets, and insert them onto the spark plug pipe edge (a).

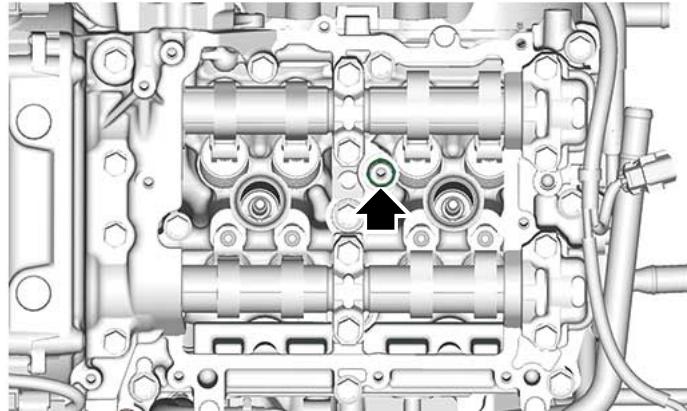
ZD-8AJ



ME-23334

2. Install new rocker cover gasket (ring type) to the cam carrier LH.

ZD-8AJ



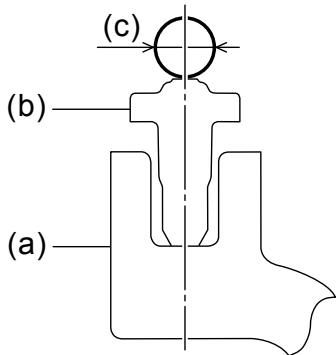
ME-23335

3. Install new rocker cover gasket LH to the rocker cover LH.
4. Apply liquid gasket to the mating surface of rocker cover LH as shown in the figure.

Note:

- Before applying liquid gasket, degrease the old liquid gasket seal surface of the engine.
- Apply liquid gasket to the center of rocker cover gasket and be careful not to allow liquid gasket to be squeezed out from rocker cover gasket.

SK-5CJ



ME-22889

(a) Rocker cover

(b) Rocker cover gasket

(c) $\varnothing 3 \pm 1$ mm
(0.1181 ± 0.0394 in)

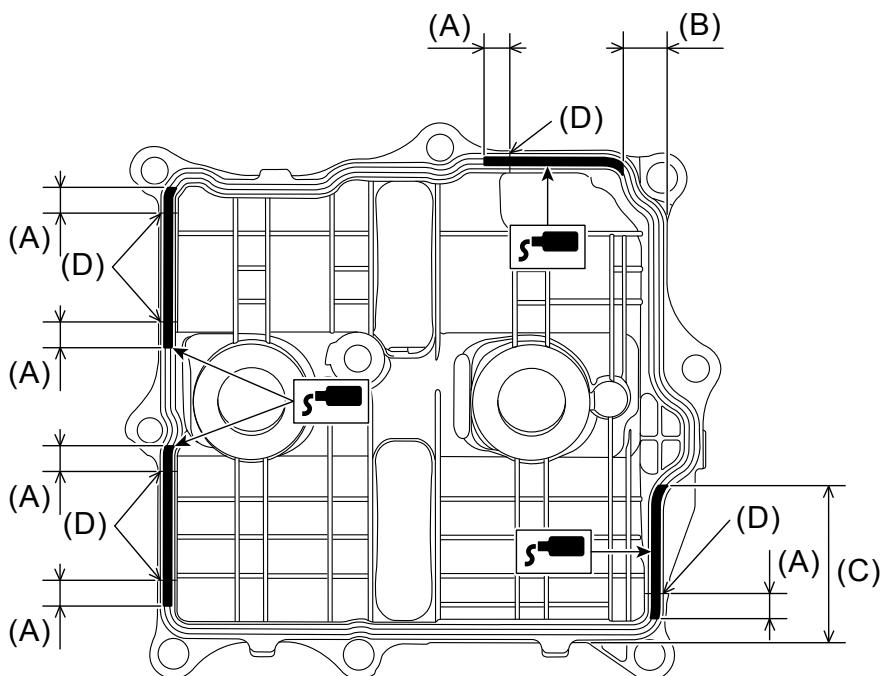
- Install within 5 min. after applying liquid gasket.

Preparation items:

Liquid gasket: THREE BOND 1217G (part No. K0877Y0100), THREE BOND 1217H or equivalent

Liquid gasket applying diameter:

3 ± 1 mm (0.1181 ± 0.0394 in)



ME-21548

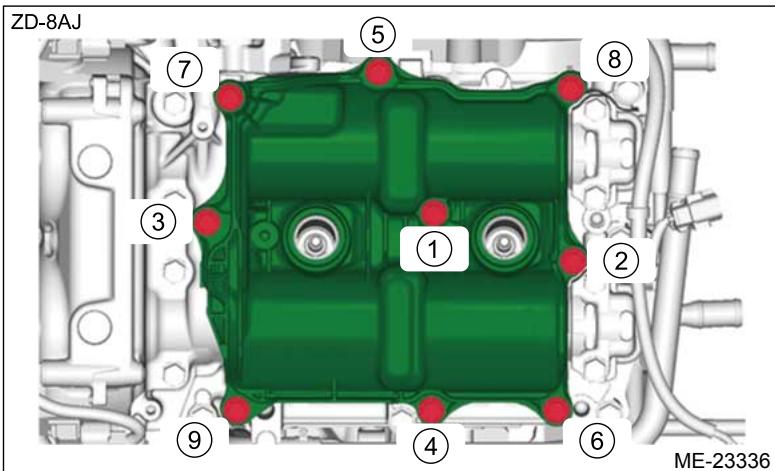
- (A) 10 mm (0.3937 in) or more (C) 63.9 mm (2.5157 in) or more (D) Arch starting point
 (B) 17.3 mm (0.6811 in) or less

5. Install the rocker cover LH to the cam carrier LH.

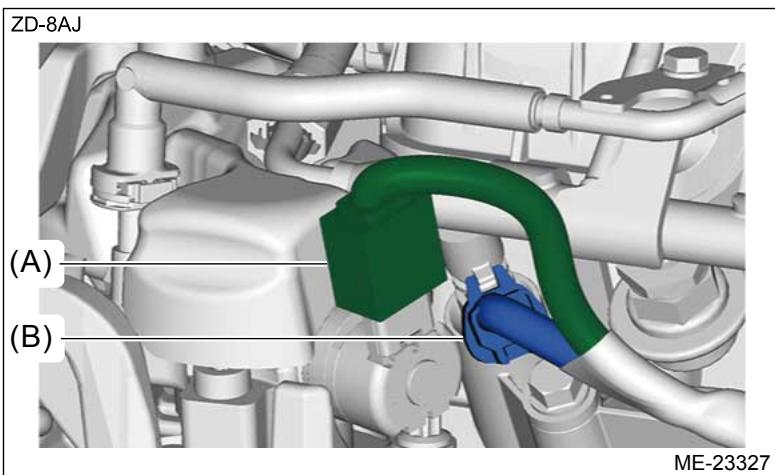
- (1) Set the rocker cover LH on the cam carrier LH, and fasten all bolts until their two or more full threads engage.
- (2) Tighten all bolts with a torque of 6.4 N·m (0.7 kgf-m, 4.7 ft-lb) in numerical order as shown in the figure.
- (3) Tighten all bolts again with a torque of 6.4 N·m (0.7 kgf-m, 4.7 ft-lb) in numerical order as shown in the figure.

Note:

This procedure is necessary to stabilize torque.



6. Connect the connector (B) to #2 fuel injector (port injection side) and connect the connector (A) to the high-pressure fuel pump.



7. Install the fuel pipe protector LH No. 1. [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>Fuel Pipe Protector>INSTALLATION>FUEL PIPE PROTECTOR LH>FUEL PIPE PROTECTOR LH NO. 1.](#)

8. Install the #2 ignition coil and the #4 ignition coil. [Ref. to IGNITION\(H4DO\)>Ignition Coil>INSTALLATION > LH SIDE.](#)

9. When working on the vehicle

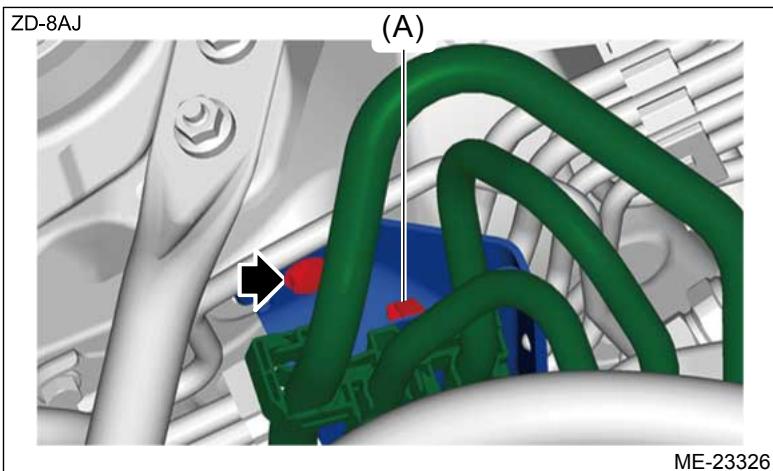
Note:

When working on the vehicle, perform the following steps also.

- (1) Install the strut tower bar LH.  Ref. to FRONT SUSPENSION>Strut Tower Bar>**INSTALLATION**.
- (2) Install the fuel protector and secure the fuel delivery tube clamp to the fuel protector with claw (A) together with each tube.

Tightening torque:

7.5 N·m (0.8 kgf-m, 5.5 ft-lb)



- (3) Connect the fuel delivery tube and evaporation hose.

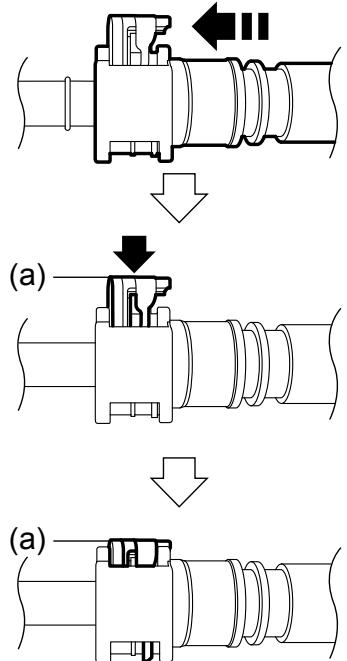
- 1) Connect the quick connector on the fuel delivery tube (port injection side) (A) to the fuel pipe LH, and connect the quick connector on the fuel delivery tube (cylinder direct injection side) (B) to the fuel delivery pipe assembly.

Caution:

- Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the pipe.
 - When connecting the quick connector, make sure to insert it all the way in before locking the slider.
 - When it is difficult to lock the slider, check that the connector is fully inserted.
 - After locking the slider, pull the quick connector itself to the disconnecting direction, and then push to the connecting direction in order to confirm secure connection.
- Always make sure to perform this confirmation ending up with a pushing in.

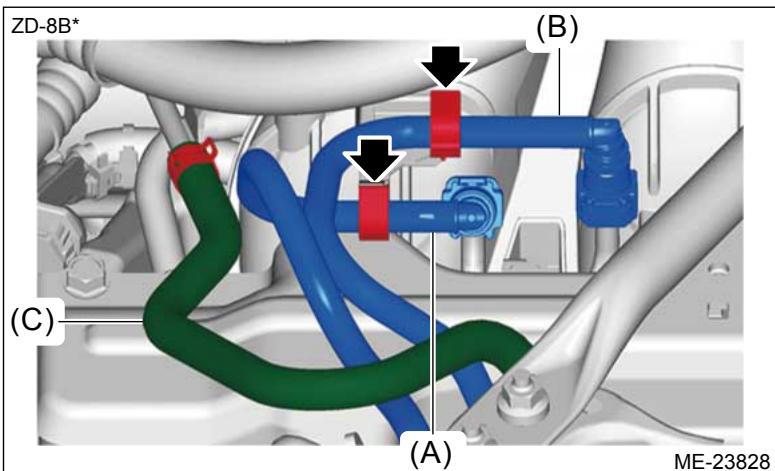
Note:

Connect the quick connector as shown in the figure.



(a) Slider

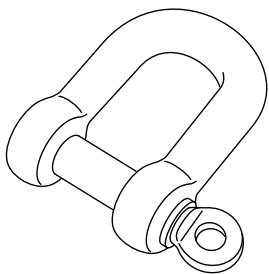
- 2) Install the fuel delivery tube (port injection side) (A) and fuel delivery tube (cylinder direct injection side) (B) to the fuel delivery tube clamp.
- 3) Connect the evaporation hose (C) to the vacuum pipe.



- (4) Lift the engine using ST1, ST2, ST3, ST4 and the shackle, and remove ST5.
 - 1) Set the ST3, ST4, and the shackle to the vehicle.

Caution:

- Use a shackle with the load capacity of 250 kg (551 lb) or more.



FS-00325

- Set the ST3, ST4, and the shackle at the locations shown in the figure.

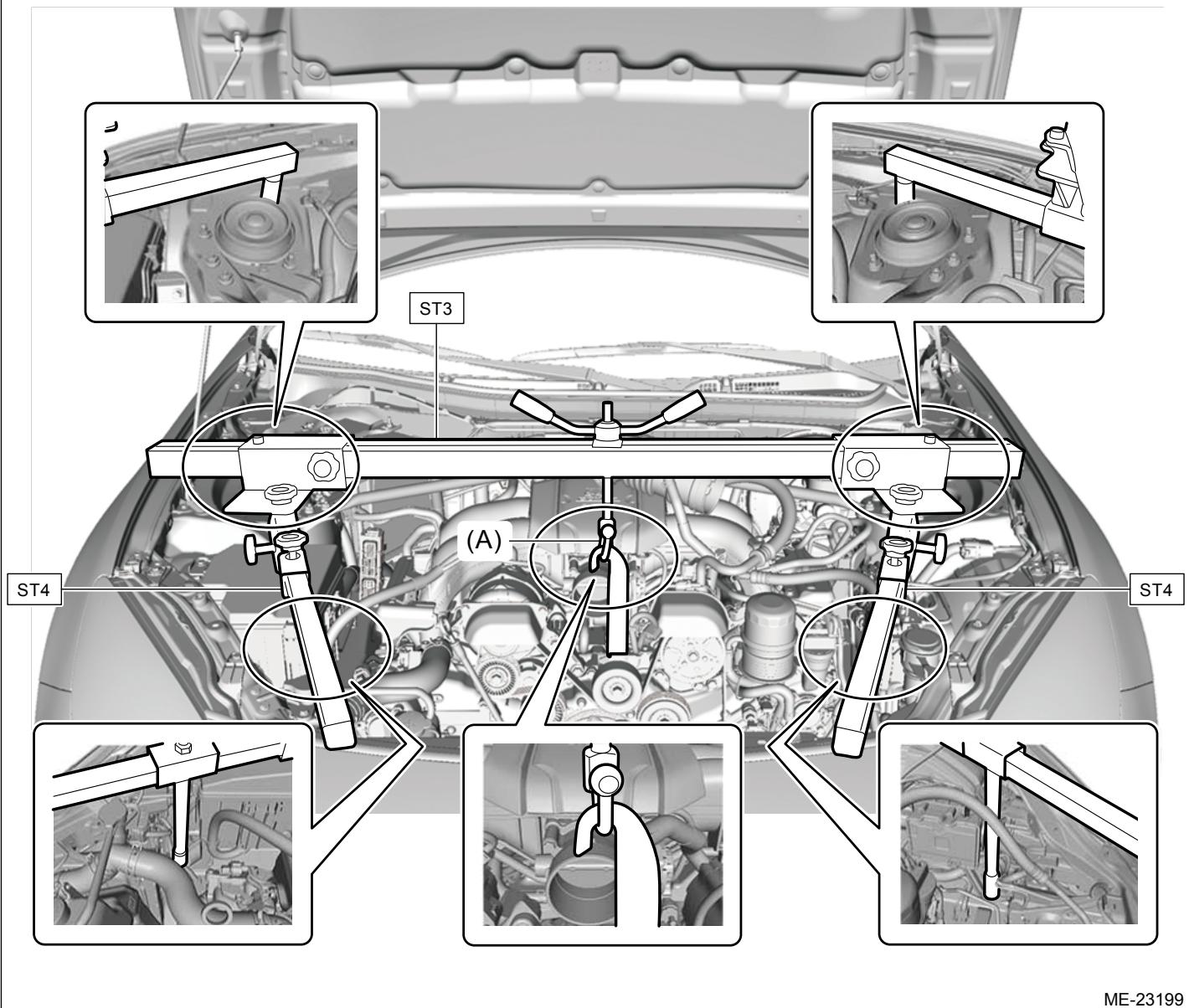
Preparation tool:

ST3: ENGINE HANGER (99099AJ000)

ST4: ADJUSTER (18679AA020)

General tool:

Shackle



ME-23199

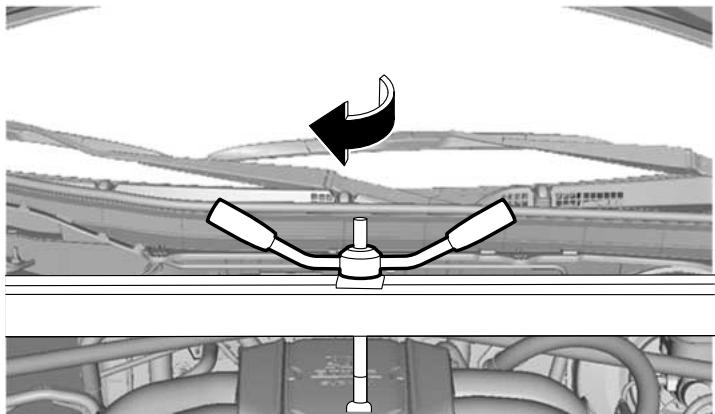
(A) Shackle

2) Turn the handle clockwise to lift the engine gradually and remove the ST5.

Caution:

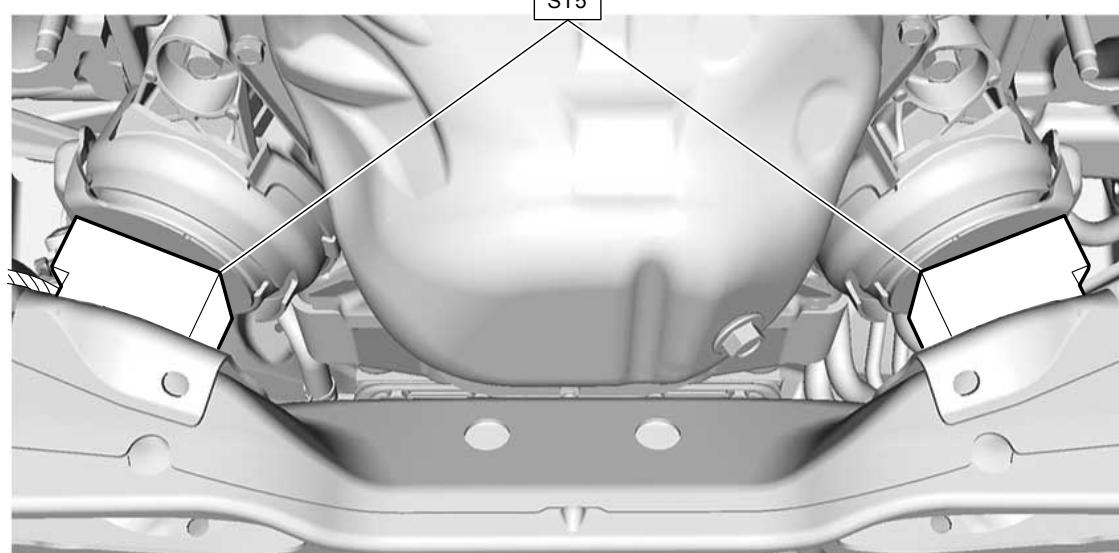
- To prevent damage to the threaded portion of the handle, apply grease or lubricants to the threaded portion before starting the work.
- When lifting up the engine unit, pay attention to the clearance of each part and be careful not to lift the engine too much, in order to prevent damaging the vehicle.

ZD-8AU



ME-23512

ZD-8AJ



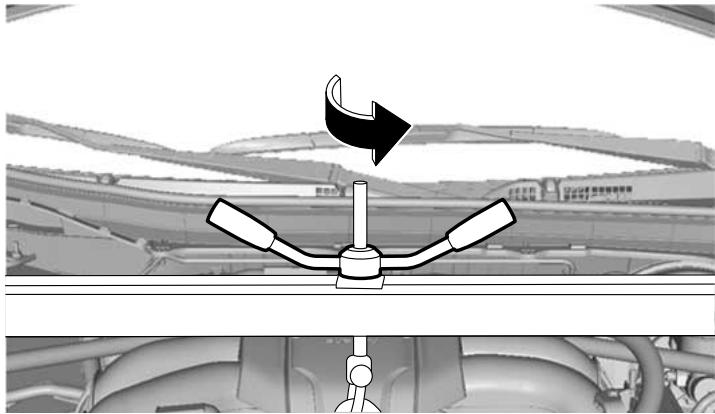
ME-23321

3) Turn the handle counterclockwise to lower the engine gradually and insert the stud bolt of the engine mounting into the engine mounting hole of the crossmember COMPL front.

Note:

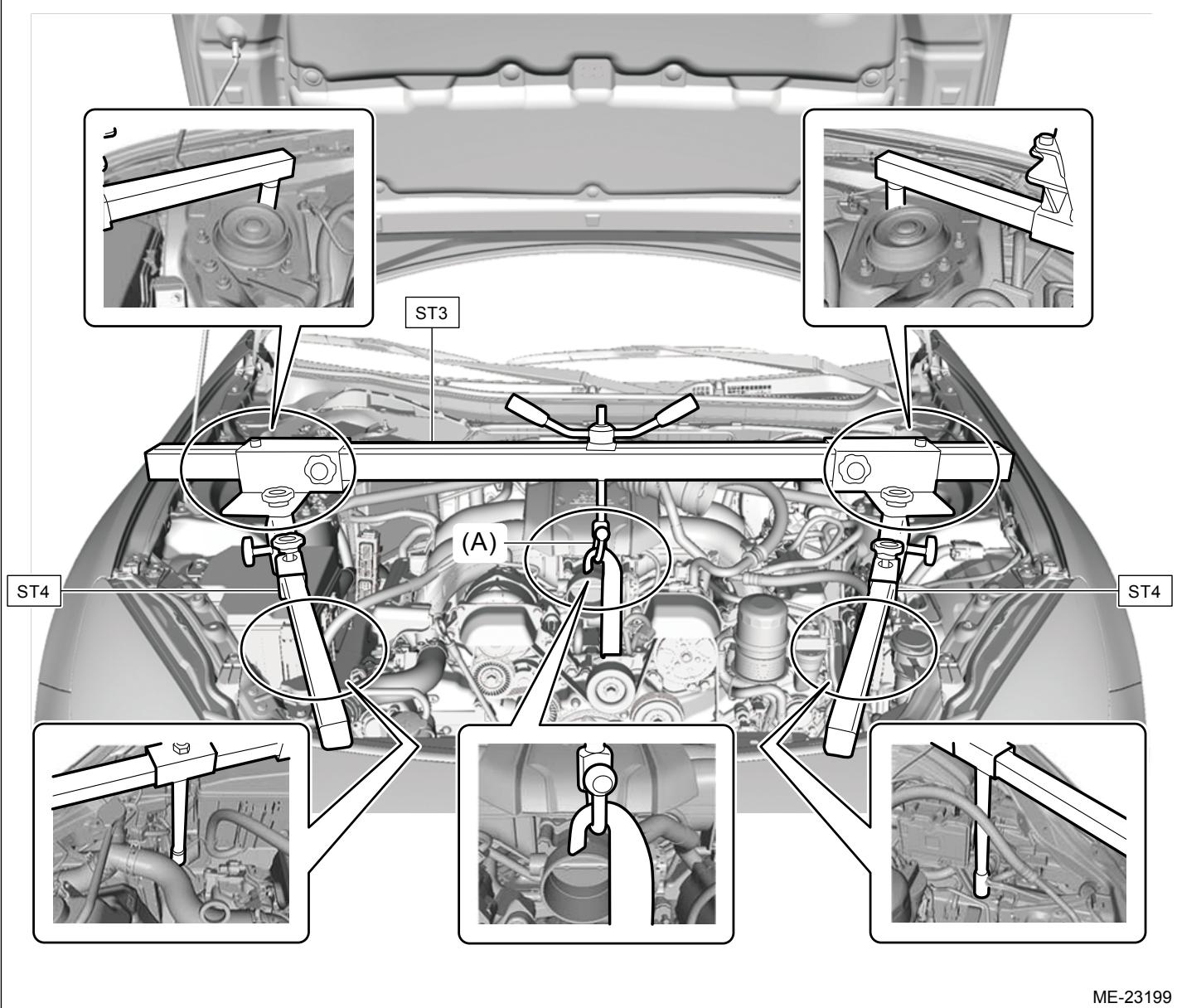
- If it is hard to insert the stud bolt of the engine mounting into the engine mounting hole of the crossmember COMPL front, lower the engine while lightly pushing it toward the rear of the vehicle.
- Check that the stud bolt of the engine mounting is securely inserted into the engine mounting hole of the crossmember COMPL front.

ZD-8AU



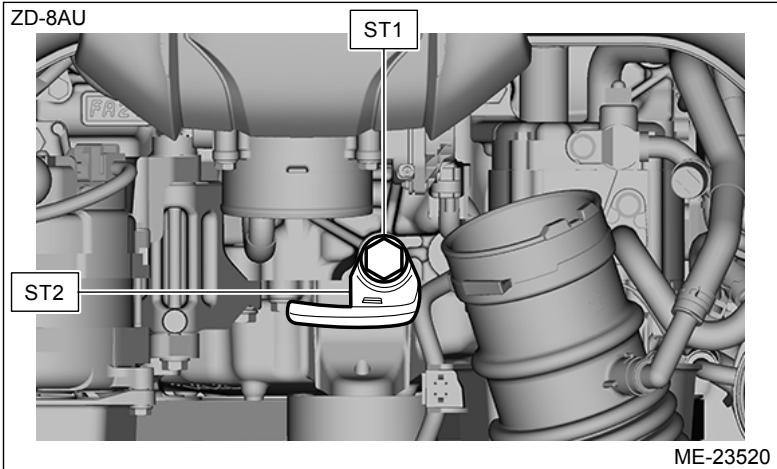
4) Remove ST3, ST4 and the shackle from the vehicle.

ZD-8AU

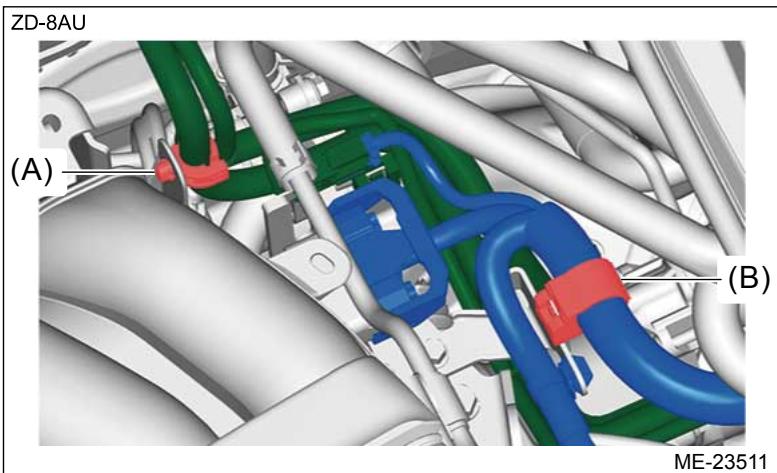


(A) Shackle

5) Remove the ST1 and ST2.



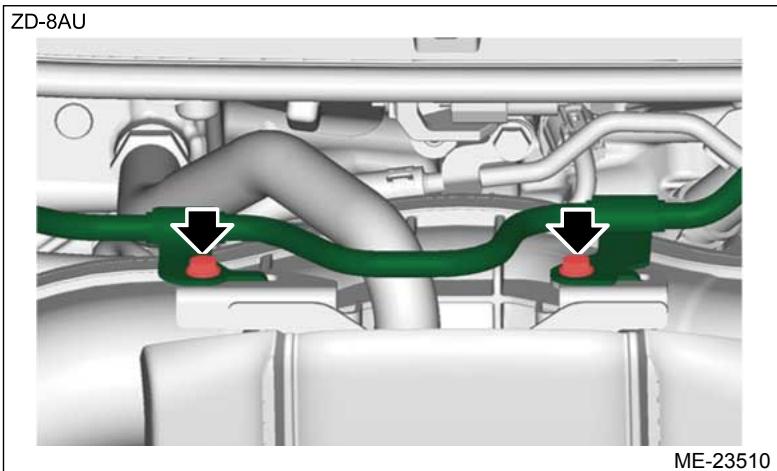
(5) Secure the bulkhead wiring harness to the engine rear hanger with clip (B), and secure the battery cable assembly to the intake manifold assembly with clip (A).



(6) Install the bolts which secure the brake vacuum pipe to the collector cover bracket No. 2.

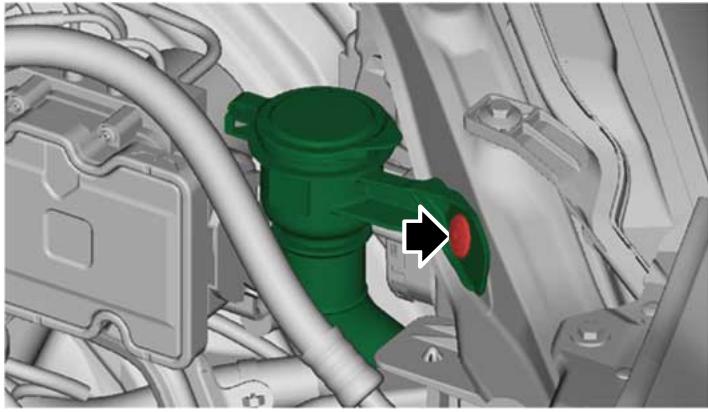
Tightening torque:

7.5 N·m (0.8 kgf-m, 5.5 ft-lb)



(7) Secure the hose inlet assembly to the vehicle with the clip.

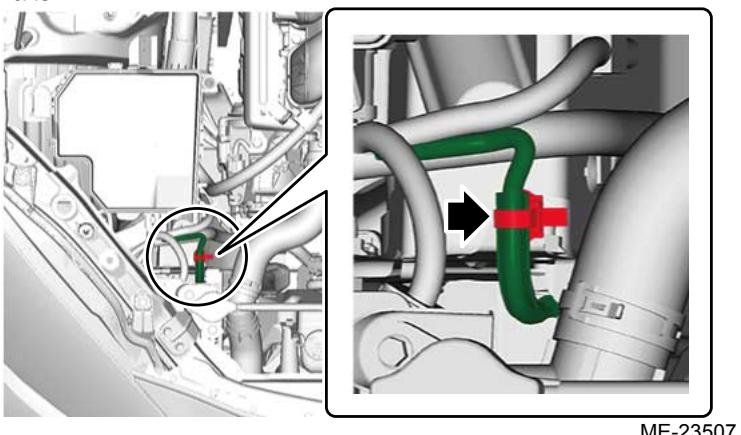
ZD-8AU



(8) Secure the bulkhead wiring harness to the vehicle with the clip.

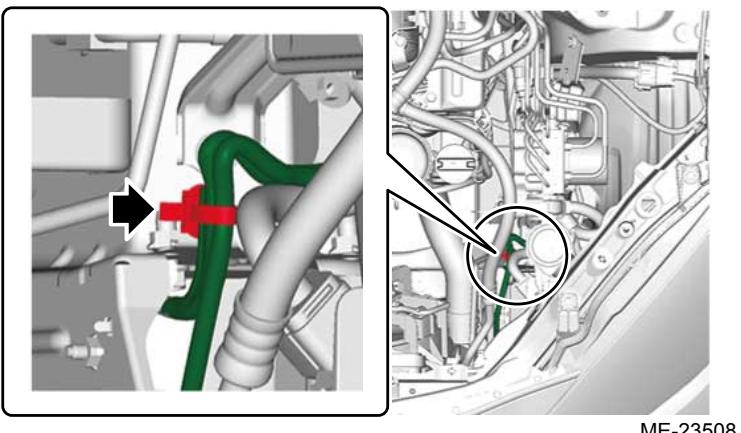
- RH side

ZD-8AU



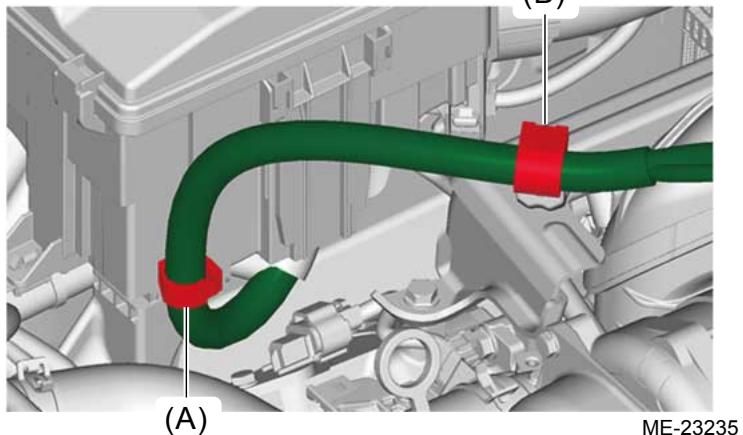
- LH side

ZD-8AU



(9) Secure the generator cord to the fuel pipe protector RH No. 1 with clip (B), and secure the generator cord to the main fuse box with clip (A).

ZD-8AJ



(10)Lift up the vehicle.

(11)Install the nuts which hold the engine mounting to the crossmember COMPL front.

Caution:

Be sure to use a new nut.

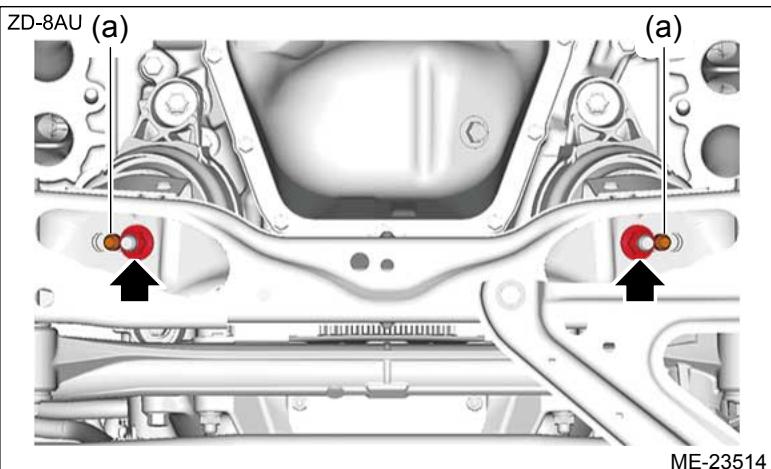
Note:

Make sure that locators (a) of the engine mounting are securely inserted.

Tightening torque:

90 N·m (9.2 kgf-m, 66.4 ft-lb)

ZD-8AU (a)



(12)Install the front exhaust pipe. [Ref. to EXHAUST\(H4DO\)>Front Exhaust Pipe>INSTALLATION.](#)

(13)Install the ECM. [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>Engine Control Module \(ECM\)>INSTALLATION.](#)

(14)Install the air intake boot. [Ref. to INTAKE \(INDUCTION\)\(H4DO\)>Air Intake Boot>INSTALLATION.](#)

(15)Connect the ground terminal to the battery sensor. [Ref. to REPAIR CONTENTS>NOTE > BATTERY.](#)

(16)Set the panel COMPL front hood to the normal position. [Ref. to REPAIR CONTENTS>NOTE > STAY ASSEMBLY FRONT HOOD.](#)

(17)Check the select lever and adjust it if necessary. (AT model)

Inspection:

[Ref. to CONTROL SYSTEMS>Select Lever>INSPECTION.](#)

Adjustment:

[Ref. to CONTROL SYSTEMS>Select Lever>ADJUSTMENT.](#)

Note:

This procedure is required because the select lever may be deviated from the adjusted position due to installation/removal of the nut on the engine mounting.

MECHANICAL(H4DO) > Rocker Cover

INSPECTION

Check that the rocker cover does not have deformation, cracks and any other damage.

MECHANICAL(H4DO) > Camshaft

REMOVAL

1. CAMSHAFT RH

The camshaft RH and cam carrier are designed as removing as a unit. Refer to "Cam Carrier" for removal procedures of camshaft RH.

-  [Ref. to MECHANICAL\(H4DO\)>Cam Carrier>REMOVAL > CAM CARRIER RH.](#)
-  [Ref. to MECHANICAL\(H4DO\)>Cam Carrier>DISASSEMBLY > CAM CARRIER RH.](#)

2. CAMSHAFT LH

The camshaft LH and cam carrier are designed as removing as a unit. Refer to "Cam Carrier" for removal procedures of camshaft LH.

-  [Ref. to MECHANICAL\(H4DO\)>Cam Carrier>REMOVAL > CAM CARRIER LH.](#)
-  [Ref. to MECHANICAL\(H4DO\)>Cam Carrier>DISASSEMBLY > CAM CARRIER LH.](#)

MECHANICAL(H4DO) > Camshaft

INSTALLATION

1. CAMSHAFT RH

The camshaft RH and cam carrier are designed as installing as a unit. Refer to "Cam Carrier" for installation procedures of camshaft RH.

-  [Ref. to MECHANICAL\(H4DO\)>Cam Carrier>ASSEMBLY > CAM CARRIER RH.](#)
-  [Ref. to MECHANICAL\(H4DO\)>Cam Carrier>INSTALLATION > CAM CARRIER RH.](#)

2. CAMSHAFT LH

The camshaft LH and cam carrier are designed as installing as a unit. Refer to "Cam Carrier" for installation procedures of camshaft LH.

-  [Ref. to MECHANICAL\(H4DO\)>Cam Carrier>ASSEMBLY > CAM CARRIER LH.](#)
-  [Ref. to MECHANICAL\(H4DO\)>Cam Carrier>INSTALLATION > CAM CARRIER LH.](#)

MECHANICAL(H4DO) > Camshaft

INSPECTION

Refer to "Cam Carrier" for inspection procedures of camshaft.  [Ref. to MECHANICAL\(H4DO\)>Cam Carrier>INSPECTION.](#)

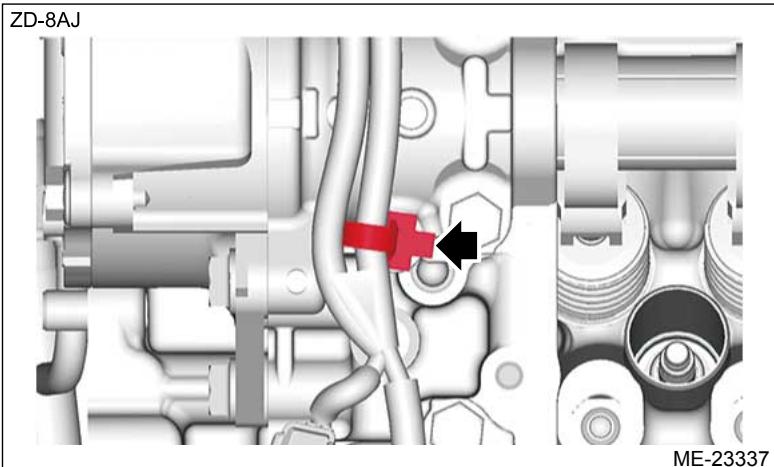
MECHANICAL(H4DO) > Cam Carrier

REMOVAL



1. CAM CARRIER RH

1. Remove the engine unit from the vehicle. [Ref. to MECHANICAL\(H4DO\)>Engine Assembly>REMOVAL.](#)
2. Remove the timing chain RH. [Ref. to MECHANICAL\(H4DO\)>Timing Chain Assembly>REMOVAL > TIMING CHAIN RH.](#)
3. Remove the rocker cover RH. [Ref. to MECHANICAL\(H4DO\)>Rocker Cover>REMOVAL > ROCKER COVER RH.](#)
4. Remove the fuel pipe protector RH No. 2. [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>Fuel Pipe Protector>REMOVAL>FUEL PIPE PROTECTOR RH >FUEL PIPE PROTECTOR RH NO. 2.](#)
5. Remove the clip holding the engine wiring harness from cam carrier RH.



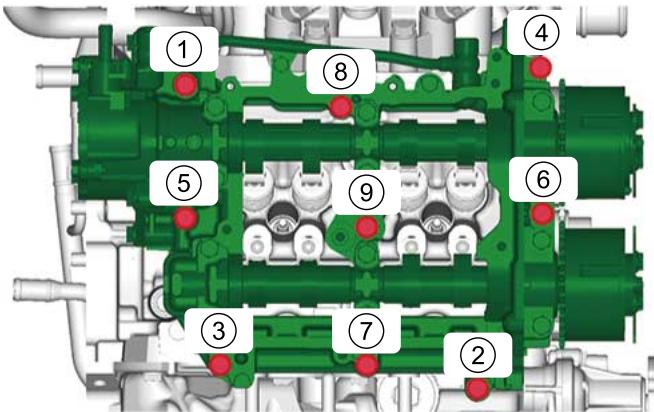
6. When disassembling the cam carrier RH

Note:

When disassembling the cam carrier RH, perform the following steps also.

- (1) Remove the oil pipe. [Ref. to LUBRICATION\(H4DO\)>Oil Pipe>REMOVAL.](#)
 - (2) Remove the vacuum pump. [Ref. to MECHANICAL\(H4DO\)>Vacuum Pump>REMOVAL.](#)
 - (3) Remove the cam sprocket RH. [Ref. to MECHANICAL\(H4DO\)>Cam Sprocket>REMOVAL > CAM SPROCKET RH.](#)
7. Set the part so that the cam carrier RH is on the upper side.
 8. Loosen the bolts holding the cam carrier RH equally, a little at a time in numerical sequence as shown in the figure and remove the cam carrier RH.

ZD-8AJ



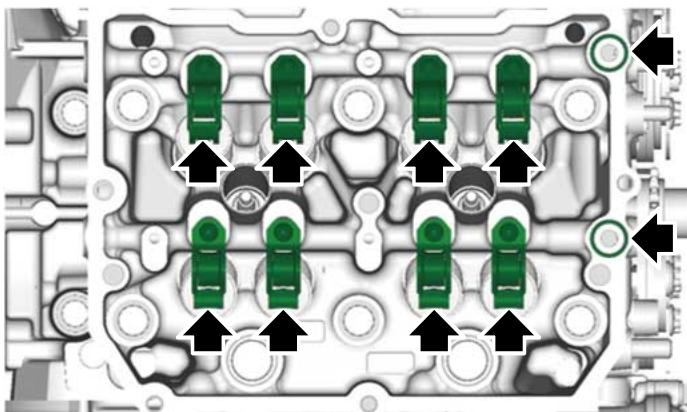
ME-23338

- 9.** Remove the O-ring and the roller rocker arm from cylinder head RH.

Note:

Be careful not to confuse the roller rocker arms.

ZD-8AJ



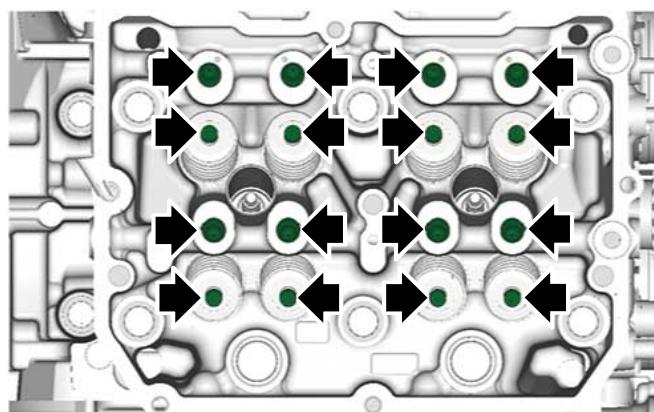
ME-23339

- 10.** Remove the valve shim and the roller rocker arm pivot from cylinder head RH.

Note:

Be careful not to confuse the valve shim and the roller rocker arm pivot.

ZD-8AJ

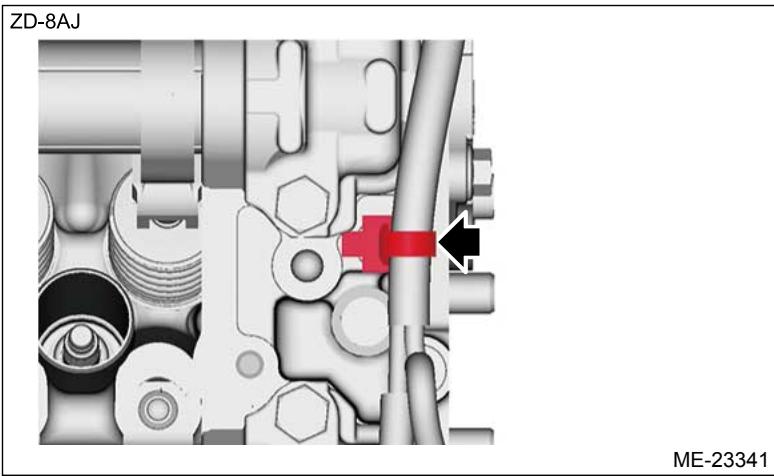


ME-23340

- 11.** Remove the liquid gasket from cam carrier RH and cylinder head RH.

2. CAM CARRIER LH

1. Remove the engine unit from the vehicle. [Ref. to MECHANICAL\(H4DO\)>Engine Assembly>REMOVAL.](#)
2. Remove the timing chain LH. [Ref. to MECHANICAL\(H4DO\)>Timing Chain Assembly>REMOVAL > TIMING CHAIN LH.](#)
3. Remove the rocker cover LH. [Ref. to MECHANICAL\(H4DO\)>Rocker Cover>REMOVAL > ROCKER COVER LH.](#)
4. Remove the water pipe. [Ref. to COOLING\(H4DO\)>Water Pipe>REMOVAL > WATER PIPE.](#)
5. Remove the high-pressure fuel pump. [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>High Pressure Fuel Pump>REMOVAL.](#)
6. Remove the high-pressure fuel pump case. [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>High Pressure Fuel Pump>REMOVAL > HIGH-PRESSURE FUEL PUMP CASE.](#)
7. Remove the clip holding the engine wiring harness from cam carrier LH.

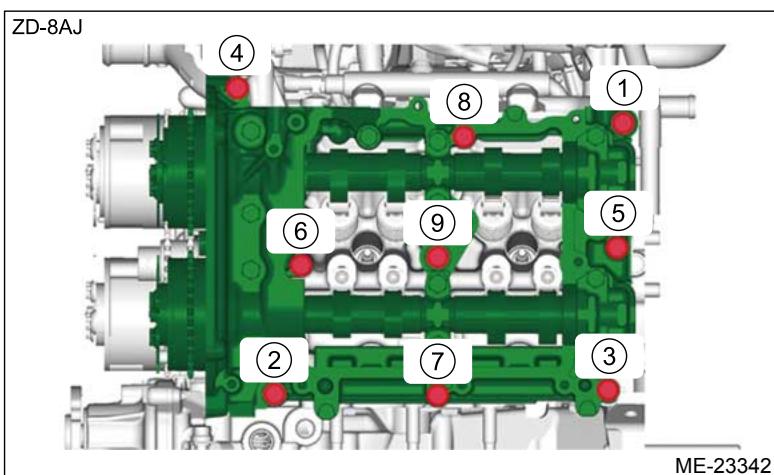


8. When disassembling the cam carrier LH

Note:

When disassembling the cam carrier LH, perform the following steps also.

- (1) Remove the cam sprocket LH. [Ref. to MECHANICAL\(H4DO\)>Cam Sprocket>REMOVAL > CAM SPROCKET LH.](#)
9. Set the part so that the cam carrier LH is on the upper side.
10. Loosen the bolts holding the cam carrier LH equally, a little at a time in numerical sequence as shown in the figure and remove the cam carrier LH.

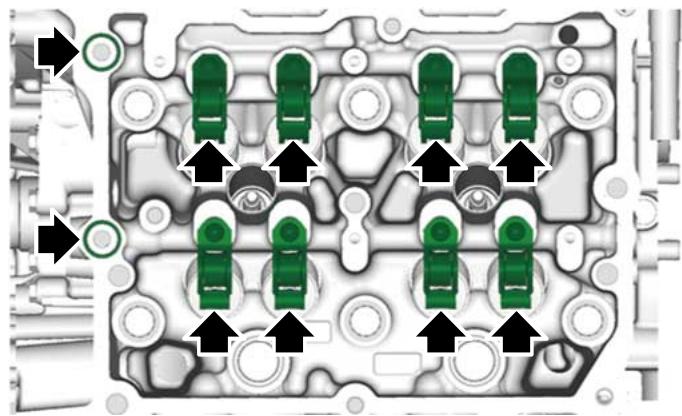


11. Remove the O-ring and the roller rocker arm from cylinder head LH.

Note:

Be careful not to confuse the roller rocker arms.

ZD-8AJ

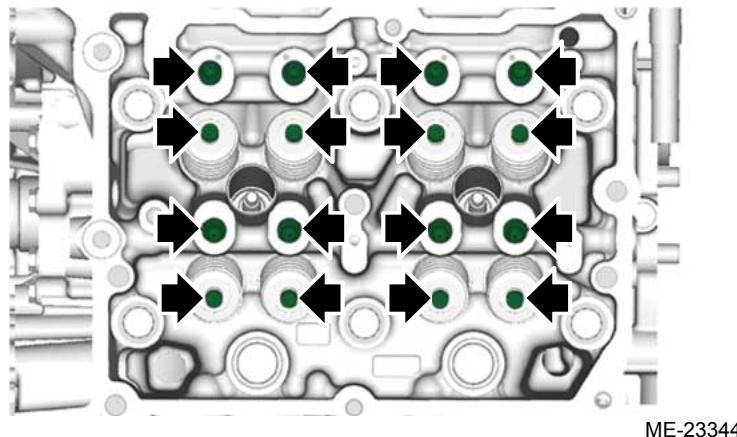


12. Remove the valve shim and the roller rocker arm pivot from cylinder head LH.

Note:

Be careful not to confuse the valve shim and the roller rocker arm pivot.

ZD-8AJ



13. Remove the liquid gasket from cam carrier LH and cylinder head LH.

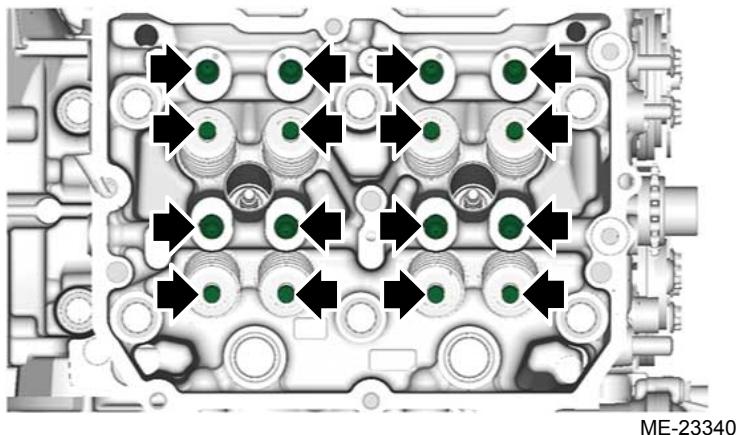
MECHANICAL(H4DO) > Cam Carrier

INSTALLATION

1. CAM CARRIER RH

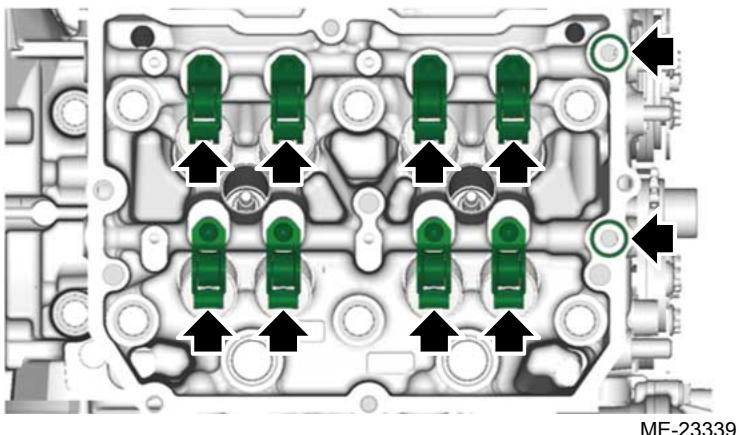
1. Set the part so that the cylinder head RH is on the upper side.
2. Apply engine oil to the valve shim and the roller rocker arm pivot, and install the valve shim and the roller rocker arm pivot to the cylinder head RH.

ZD-8AJ



- 3.** Apply engine oil to new O-ring and the roller rocker arm, and install the O-ring and the roller rocker arm to the cylinder head RH.

ZD-8AJ



- 4.** Apply liquid gasket to the mating surface of cam carrier RH as shown in the figure.

Note:

- Before applying liquid gasket, degrease the old liquid gasket seal surface of the cylinder head RH and cam carrier RH.
- Install within 5 min. after applying liquid gasket.

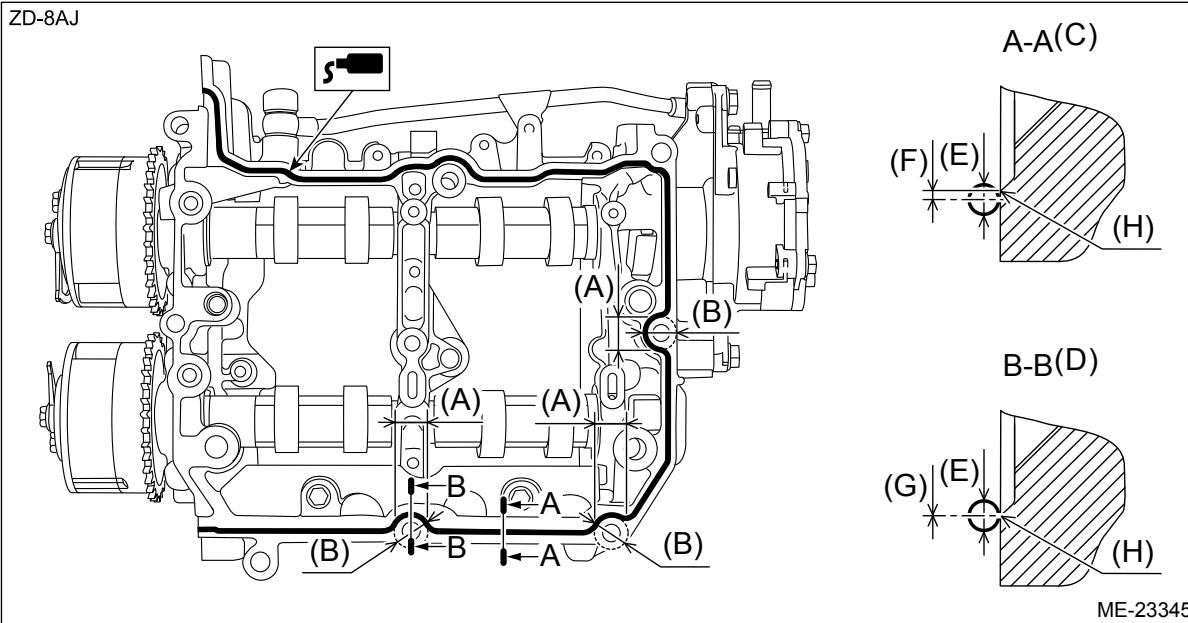
Preparation items:

Liquid gasket: THREE BOND 1217G (part No. K0877Y0100), THREE BOND 1217H or equivalent

Liquid gasket applying diameter:

$4 \pm 0.5 \text{ mm}$ ($0.1575 \pm 0.0197 \text{ in}$)

ZD-8AJ



(A) Range A

(D) Liquid gasket applying position of mating surfaces of range A

(G) $0\pm 0.5 \text{ mm} (0\pm 0.0197 \text{ in})$

(B) $\phi 18 \text{ mm} (0.7087 \text{ in})$

(E) $\phi 4\pm 0.5 \text{ mm}$
 $(0.1575\pm 0.0197 \text{ in})$

(H) Chamfer edge

(C) Liquid gasket applying position of mating surfaces other than range A

(F) $1\pm 1 \text{ mm} (0.0394\pm 0.0394 \text{ in})$

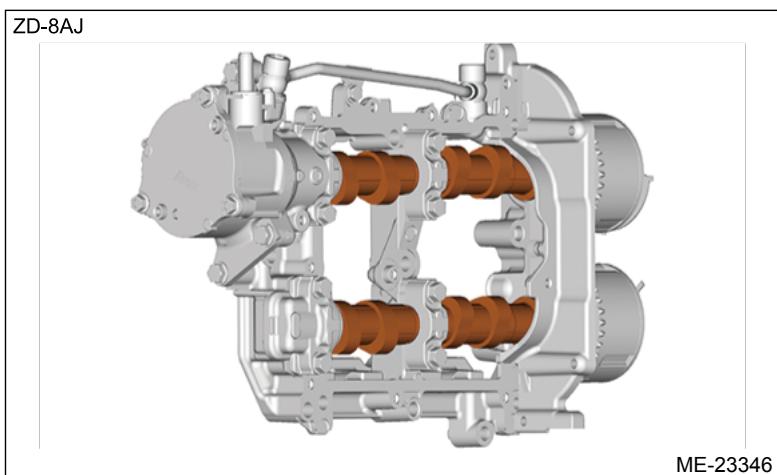
5. Install the cam carrier RH to the cylinder head RH.

(1) Set the cam carrier RH to the cylinder head RH.

Note:

Position the intake camshaft RH and the exhaust camshaft RH to the zero-lift position as shown in the figure.

ZD-8AJ



ME-23346

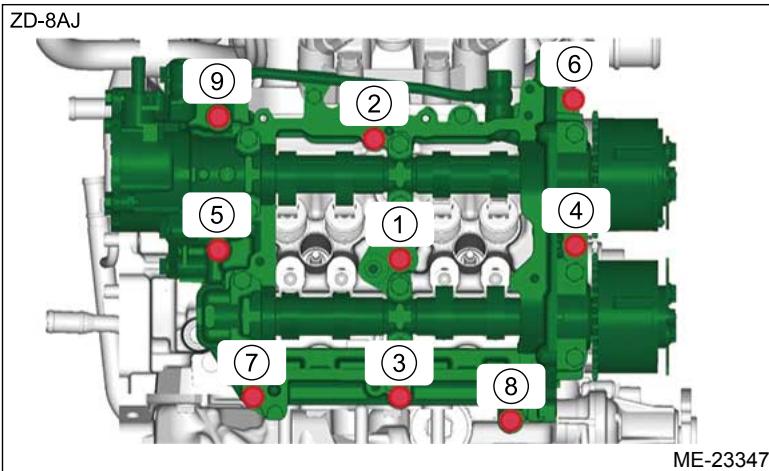
(2) Tighten all bolts with a torque of $18 \text{ N}\cdot\text{m}$ (1.8 kgf-m , 13.3 ft-lb) in numerical order as shown in the figure.

(3) Loosen the bolts (3 places) by 180° in numerical order $3 \rightarrow 2 \rightarrow 1$ as shown in the figure.

- (4) Tighten the bolts (3 places) with a torque of 18 N·m (1.8 kgf-m, 13.3 ft-lb) in numerical order 1 → 2 → 3 as shown in the figure.
- (5) Loosen the bolts (3 places) by 180° in numerical order 8 → 6 → 4 as shown in the figure.
- (6) Tighten the bolts (3 places) with a torque of 18 N·m (1.8 kgf-m, 13.3 ft-lb) in numerical order 4 → 6 → 8 as shown in the figure.
- (7) Loosen the bolts (3 places) by 180° in numerical order 7 → 9 → 5 as shown in the figure.
- (8) Tighten the bolts (3 places) with a torque of 18 N·m (1.8 kgf-m, 13.3 ft-lb) in numerical order 5 → 9 → 7 as shown in the figure.

Note:

After tightening, if the liquid gasket is squeezed out onto the seal surface of the chain cover, completely remove any squeezed-out liquid gasket.



6. Set the part so that the intake manifold is on the upper side.
7. When the cam carrier RH has been disassembled

Note:

When the cam carrier RH has been disassembled, perform the following steps also.

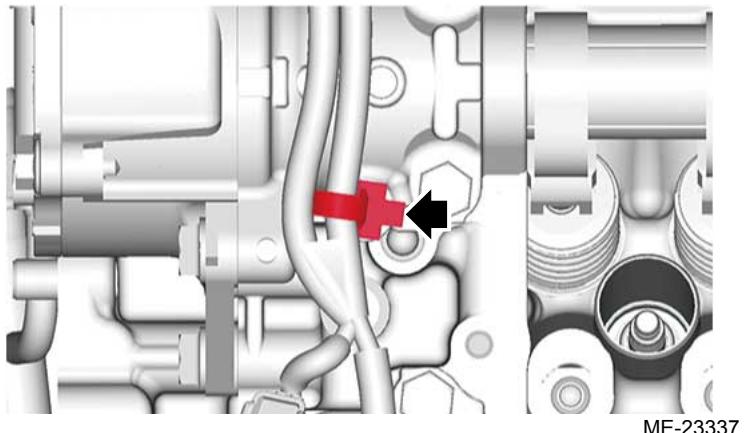
- (1) Install the cam sprocket RH. Ref. to MECHANICAL(H4DO)>Cam Sprocket>INSTALLATION > CAM SPROCKET RH.
- (2) Install the vacuum pump. Ref. to MECHANICAL(H4DO)>Vacuum Pump>INSTALLATION.

Note:

When installing the vacuum pump, do not turn the intake camshaft RH to the outside of range of zero-lift (in range where it can be turned lightly by hand).

- (3) Install the oil pipe. Ref. to LUBRICATION(H4DO)>Oil Pipe>INSTALLATION.
8. Check the cam clearance. Ref. to MECHANICAL(H4DO)>Cam Clearance>INSPECTION.
9. Secure the engine wiring harness to the cam carrier RH with a clip.

ZD-8AJ

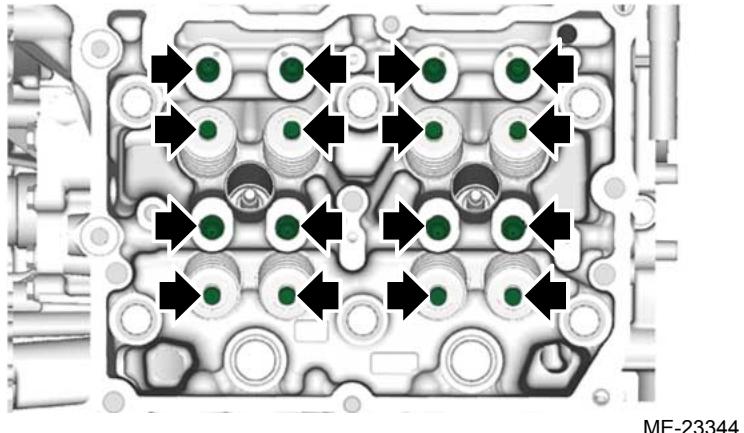


- 10.** Install the fuel pipe protector RH No. 2. Ref. to FUEL INJECTION (FUEL SYSTEMS)(H4DO)>Fuel Pipe Protector>INSTALLATION>FUEL PIPE PROTECTOR RH >FUEL PIPE PROTECTOR RH NO. 2.
- 11.** Install the rocker cover RH. Ref. to MECHANICAL(H4DO)>Rocker Cover>INSTALLATION > ROCKER COVER RH.
- 12.** Install the timing chain RH. Ref. to MECHANICAL(H4DO)>Timing Chain Assembly>INSTALLATION > TIMING CHAIN RH.
- 13.** Install the engine unit to the vehicle. Ref. to MECHANICAL(H4DO)>Engine Assembly>INSTALLATION.

2. CAM CARRIER LH

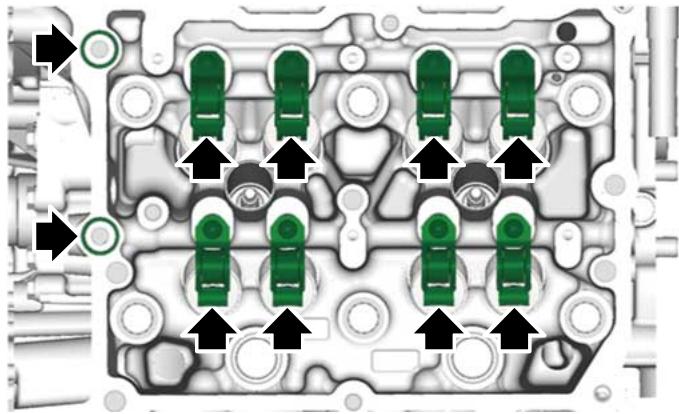
- 1.** Set the part so that the cylinder head LH is on the upper side.
- 2.** Apply engine oil to the valve shim and the roller rocker arm pivot, and install the valve shim and the roller rocker arm pivot to the cylinder head LH.

ZD-8AJ



- 3.** Apply engine oil to new O-ring and the roller rocker arm, and install the O-ring and the roller rocker arm to the cylinder head LH.

ZD-8AJ



ME-23343

4. Apply liquid gasket to the mating surface of cam carrier LH as shown in the figure.

Note:

- Before applying liquid gasket, degrease the old liquid gasket seal surface of the cylinder head LH and cam carrier LH.
- Install within 5 min. after applying liquid gasket.

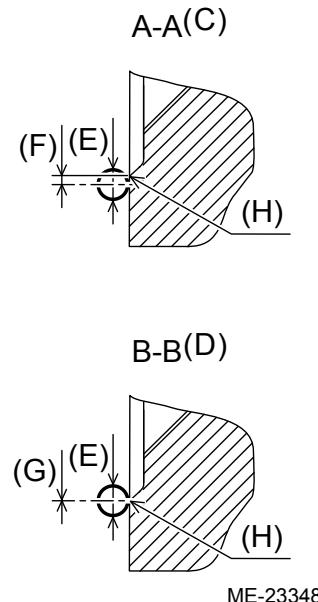
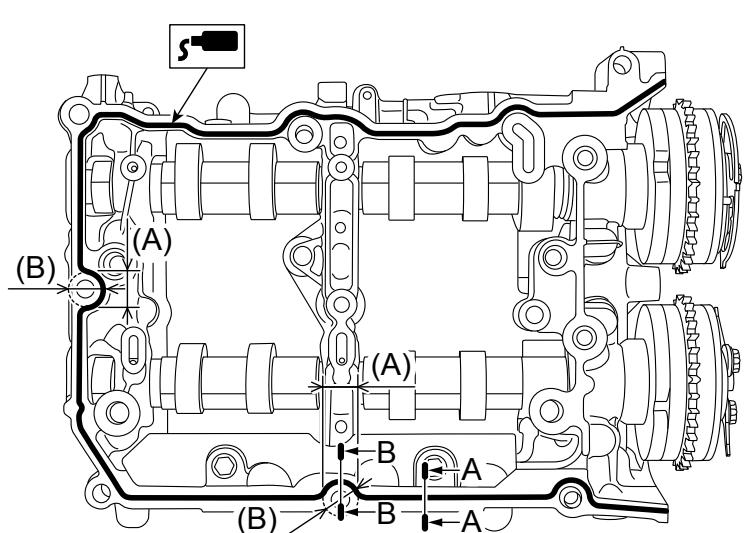
Preparation items:

Liquid gasket: THREE BOND 1217G (part No. K0877Y0100), THREE BOND 1217H or equivalent

Liquid gasket applying diameter:

$4 \pm 0.5 \text{ mm (} 0.1575 \pm 0.0197 \text{ in)}$

ZD-8AJ



ME-23348

(A) Range A

(D) Liquid gasket applying position of mating surfaces of range A

(G) $0 \pm 0.5 \text{ mm (} 0 \pm 0.0197 \text{ in)}$ (B) $\phi 18 \text{ mm (} 0.7087 \text{ in)}$ (E) $\phi 4 \pm 0.5 \text{ mm (} 0.1575 \pm 0.0197 \text{ in)}$

(H) Chamfer edge

(C) Liquid gasket applying position of mating surfaces other than range A

(F) $1 \pm 1 \text{ mm (} 0.0394 \pm 0.0394 \text{ in)}$

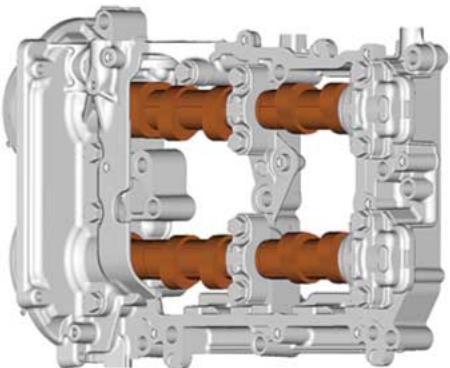
5. Install the cam carrier LH to the cylinder head LH.

(1) Set the cam carrier LH to the cylinder head LH.

Note:

Position the intake camshaft LH and the exhaust camshaft LH to the zero-lift position as shown in the figure.

ZD-8AJ



ME-23349

(2) Tighten all bolts with a torque of 18 N·m (1.8 kgf-m, 13.3 ft-lb) in numerical order as shown in the figure.

(3) Loosen the bolts (3 places) by 180° in numerical order 3 → 2 → 1 as shown in the figure.

(4) Tighten the bolts (3 places) with a torque of 18 N·m (1.8 kgf-m, 13.3 ft-lb) in numerical order 1 → 2 → 3 as shown in the figure.

(5) Loosen the bolts (3 places) by 180° in numerical order 8 → 6 → 4 as shown in the figure.

(6) Tighten the bolts (3 places) with a torque of 18 N·m (1.8 kgf-m, 13.3 ft-lb) in numerical order 4 → 6 → 8 as shown in the figure.

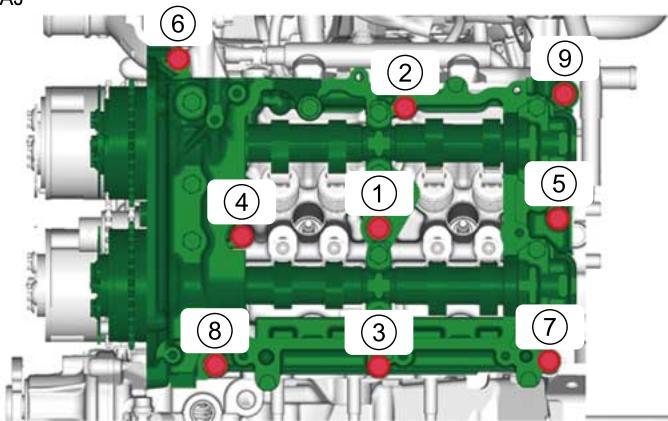
(7) Loosen the bolts (3 places) by 180° in numerical order 7 → 9 → 5 as shown in the figure.

(8) Tighten the bolts (3 places) with a torque of 18 N·m (1.8 kgf-m, 13.3 ft-lb) in numerical order 5 → 9 → 7 as shown in the figure.

Note:

After tightening, if the liquid gasket is squeezed out onto the seal surface of the chain cover, completely remove any squeezed-out liquid gasket.

ZD-8AJ



ME-23350

6. Set the part so that the installation surface of the intake manifold is on the upper side.

7. When the cam carrier LH has been disassembled

Note:

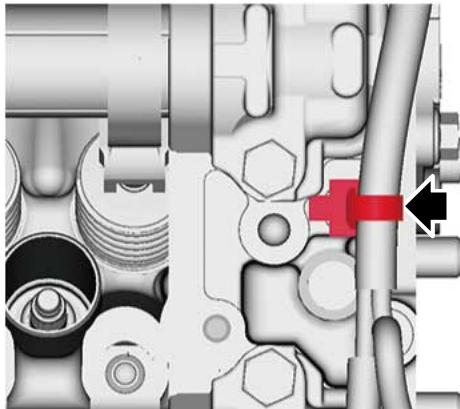
When the cam carrier LH has been disassembled, perform the following steps also.

- (1) Install the cam sprocket LH. Ref. to MECHANICAL(H4DO)>Cam Sprocket>INSTALLATION > CAM SPROCKET LH.

8. Check the cam clearance. Ref. to MECHANICAL(H4DO)>Cam Clearance>INSPECTION.

9. Secure the engine wiring harness to the cam carrier LH with a clip.

ZD-8AJ



ME-23341

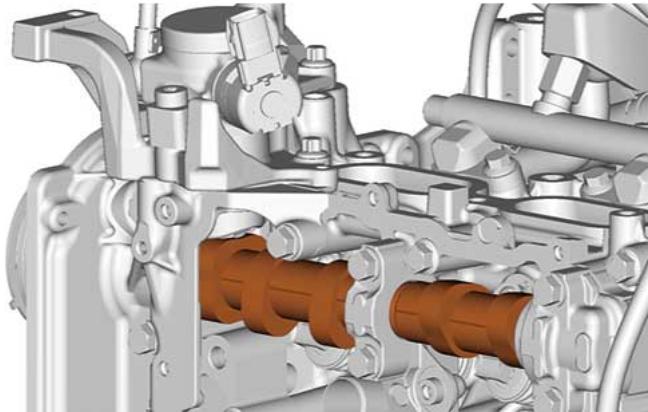
10. Install the high-pressure fuel pump case. Ref. to FUEL INJECTION (FUEL SYSTEMS)(H4DO)>High Pressure Fuel Pump>INSTALLATION > HIGH-PRESSURE FUEL PUMP CASE.

11. Install the high-pressure fuel pump. Ref. to FUEL INJECTION (FUEL SYSTEMS)(H4DO)>High Pressure Fuel Pump>INSTALLATION.

Note:

Install the high-pressure fuel pump so that the cam lobes on the intake camshaft LH are positioned as shown in the figure. Perform adjustment within the range of zero-lift (in range where it can be turned lightly by hand).

ZD-8AJ



ME-23351

12. Install the water pipe. Ref. to COOLING(H4DO)>Water Pipe>INSTALLATION > WATER PIPE.

13. Install the rocker cover LH. Ref. to MECHANICAL(H4DO)>Rocker Cover>INSTALLATION > ROCKER COVER LH.

14. Install timing chain LH. Ref. to MECHANICAL(H4DO)>Timing Chain Assembly>INSTALLATION > TIMING CHAIN LH.

15. Install the engine unit to the vehicle. Ref. to MECHANICAL(H4DO)>Engine Assembly>INSTALLATION.

MECHANICAL(H4DO) > Cam Carrier

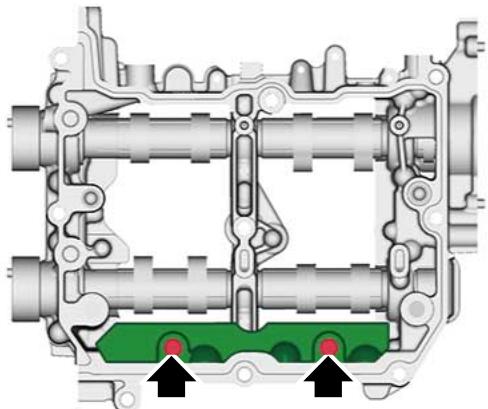
DISASSEMBLY



1. CAM CARRIER RH

1. Remove the oil spacer from cam carrier RH.

ZD-8AJ



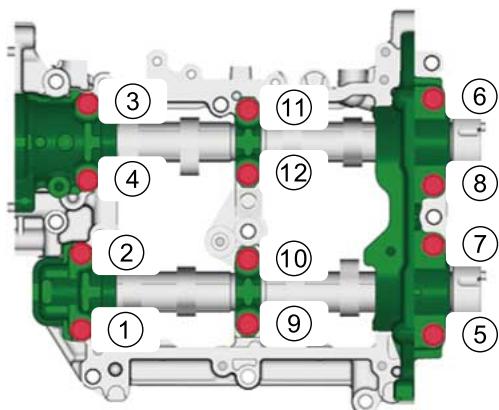
ME-23352

2. Loosen the bolts (front camshaft cap RH, intake center camshaft cap RH, intake rear camshaft cap RH, exhaust center camshaft cap RH, and exhaust rear camshaft cap RH) equally, a little at a time in numerical sequence as shown in the figure, and remove each camshaft cap.

Note:

Arrange camshaft caps in order so that they can be installed in their original positions.

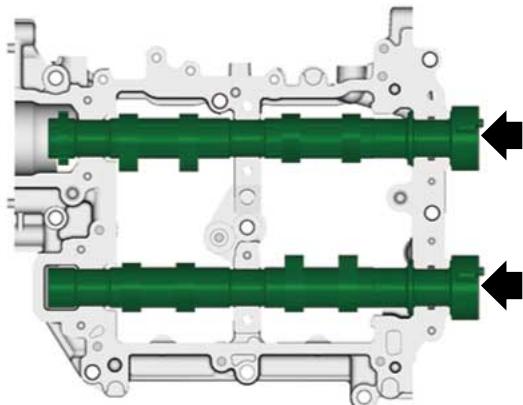
ZD-8AJ



ME-23353

3. Remove the intake camshaft RH and the exhaust camshaft RH from cam carrier RH.

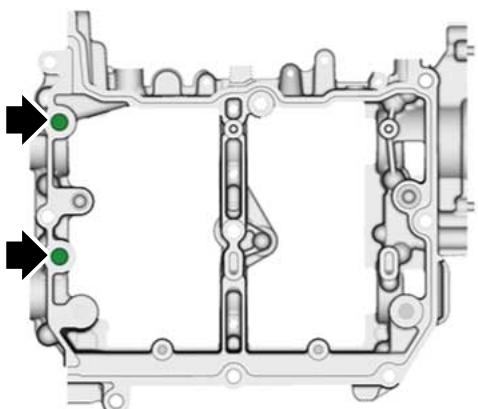
ZD-8AJ



ME-23354

4. Remove the filter from cam carrier RH.

ZD-8AJ



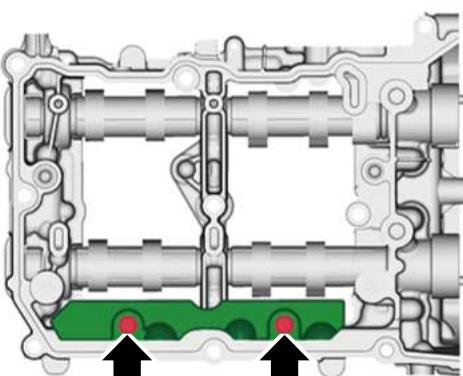
ME-23355

5. Remove the liquid gasket from cam carrier RH, front camshaft cap RH, intake rear camshaft cap RH and exhaust rear camshaft cap RH.

2. CAM CARRIER LH

1. Remove the oil spacer from cam carrier LH.

ZD-8AJ



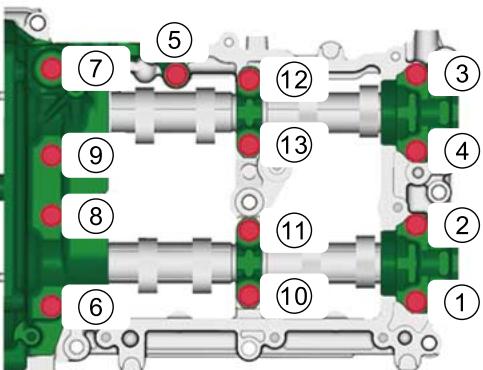
ME-23356

2. Loosen the bolts (front camshaft cap LH, intake center camshaft cap LH, intake rear camshaft cap LH, exhaust center camshaft cap LH and exhaust rear camshaft cap LH) equally, a little at a time in numerical sequence as shown in the figure, and remove each camshaft cap.

Note:

Arrange camshaft caps in order so that they can be installed in their original positions.

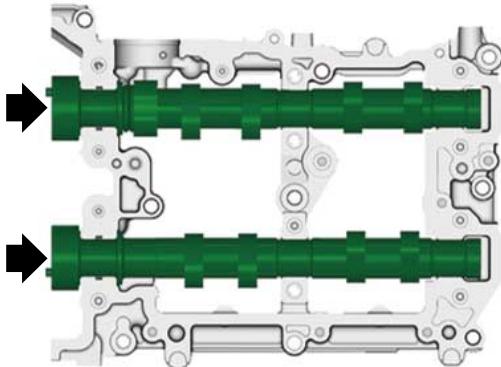
ZD-8AJ



ME-23357

3. Remove the intake camshaft LH and the exhaust camshaft LH from cam carrier LH.

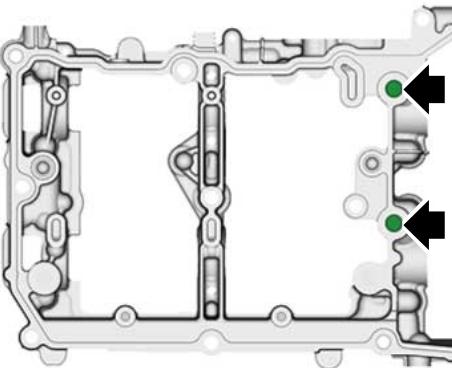
ZD-8AJ



ME-23358

4. Remove the filter from cam carrier LH.

ZD-8AJ



ME-23359

5. Remove the liquid gasket from cam carrier LH, front camshaft cap LH, intake rear camshaft cap LH and exhaust rear camshaft cap LH.

MECHANICAL(H4DO) > Cam Carrier

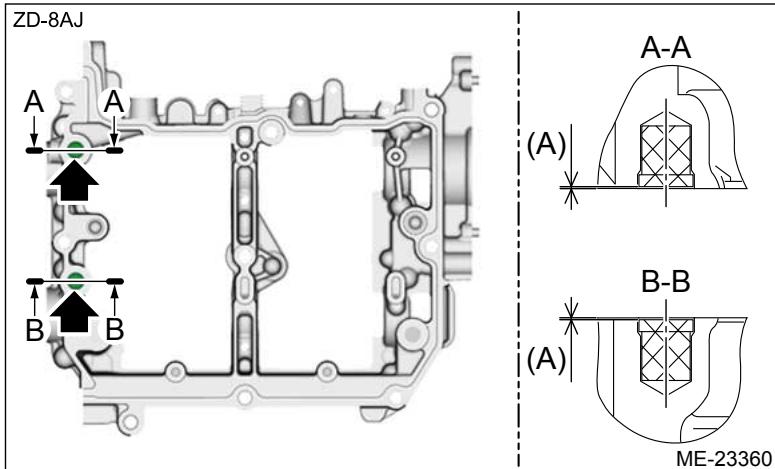
ASSEMBLY

1. CAM CARRIER RH

1. Install new filter to the cam carrier RH.

Filter insert position:

$0^{+0}_{-0.5}$ mm ($+0_{-0.0197}$ in) position from cam carrier RH end face



(A) $0 - 0.5$ mm ($0 - 0.0197$ in)

2. Set the intake camshaft RH and the exhaust camshaft RH to the cam carrier RH.

Note:

Apply engine oil to the journals of cam carrier RH before setting the intake camshaft RH and exhaust camshaft RH.

3. Install the front camshaft cap RH, intake center camshaft cap RH, intake rear camshaft cap RH, exhaust center camshaft cap RH and exhaust rear camshaft cap RH.

- (1) Apply liquid gasket to the mating surface of front camshaft cap RH, intake rear camshaft cap RH and exhaust rear camshaft cap RH as shown in the figure.

Caution:

- Do not apply liquid gasket excessively. Applying excessively may cause excess gasket to flow toward camshaft journal, resulting in engine seizure.
- Do not apply liquid gasket excessively to the intake center camshaft cap RH and exhaust center camshaft cap RH.

Note:

- Before applying liquid gasket, degrease the old liquid gasket seal surface of the front camshaft cap RH, intake rear camshaft cap RH, exhaust rear camshaft cap RH, and cam carrier RH.
- Install within 5 min. after applying liquid gasket.

Preparation items:

Liquid gasket: THREE BOND 1217G (part No. K0877Y0100), THREE BOND 1217H or equivalent

Liquid gasket applying diameter:

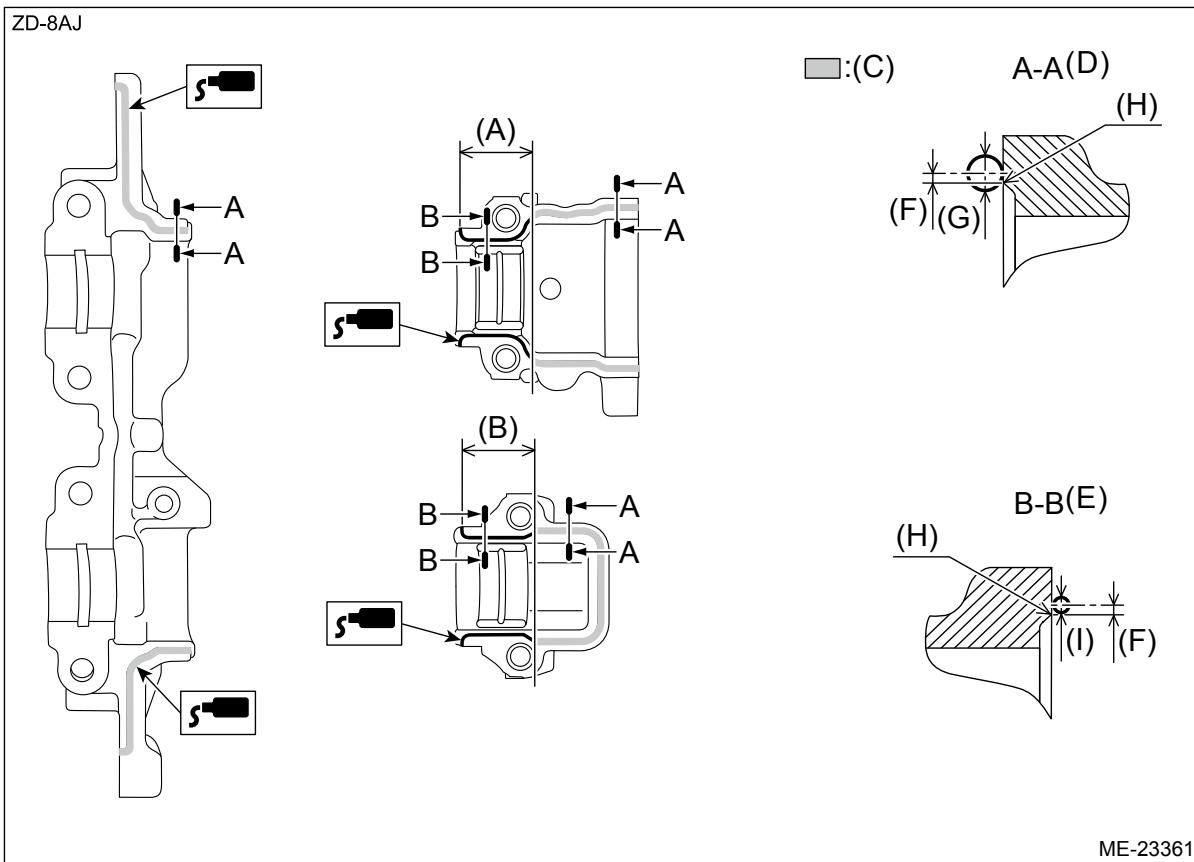
Mating surfaces other than range A

2 ± 0.5 mm (0.0787 ± 0.0197 in)

Mating surfaces of range A

$3\pm0.5 \text{ mm (}0.1181\pm0.0197 \text{ in)}$

ZD-8AJ



ME-23361

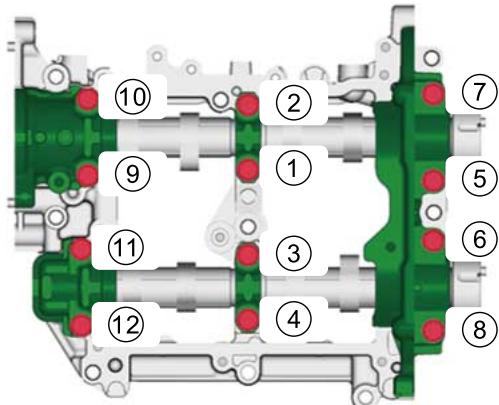
- | | | |
|-------------------------|---|---|
| (A) 29 mm (1.1417 in) | (D) Liquid gasket applying position of mating surfaces of range A | (G) $\phi 3\pm0.5 \text{ mm}$
$(0.1181\pm0.0197 \text{ in})$ |
| (B) 28.5 mm (1.1220 in) | (E) Liquid gasket applying position of mating surfaces other than range A | (H) Chamfer edge |
| (C) Range A | (F) Within 1 mm (0.0394 in) | (I) $\phi 2\pm0.5 \text{ mm}$
$(0.0787\pm0.0197 \text{ in})$ |

- (2) Apply engine oil to the journals of each camshaft cap before setting the camshaft cap.
- (3) Tighten the bolts which secure front camshaft cap RH, intake center camshaft cap RH, intake rear camshaft cap RH, exhaust center camshaft cap RH and exhaust rear camshaft cap RH in numerical order as shown in the figure.

Tightening torque:

18 N·m (1.8 kgf-m, 13.3 ft-lb)

ZD-8AJ



ME-23362

- (4) Remove liquid gasket from the vacuum pump installation area.

Note:

This procedure is required to prevent contact between the vacuum pump coupling and liquid gasket and seal deterioration.

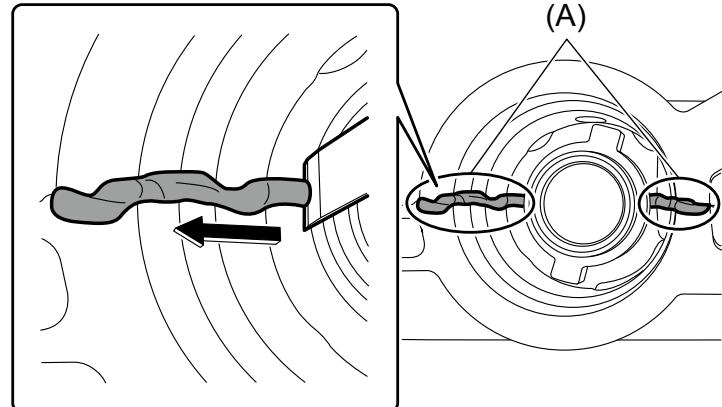
- 1) Using a scraper, remove liquid gasket at (A) in the direction of the arrow shown in the figure (from inside to outside).

Caution:

As sealability may deteriorate, perform the operation while being careful of the following.

- After installing the camshaft cap, remove liquid gasket within five minutes.
- Do not use a cloth to remove liquid gasket.
- Do not remove liquid gasket in the opposite direction of the arrow (from outside to inside).

ZD-8AJ



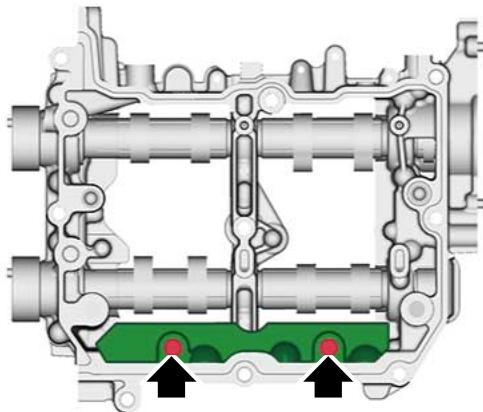
ME-23374

- 4.** Install the oil spacer to the cam carrier RH.

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

ZD-8AJ



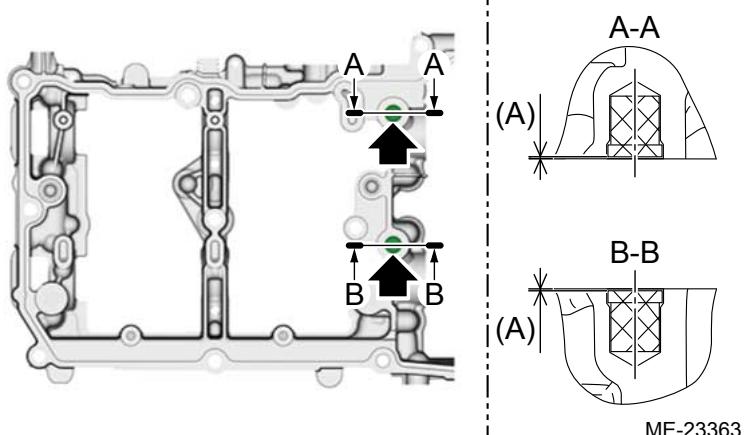
2. CAM CARRIER LH

1. Install new filter to the cam carrier LH.

Filter insert position:

$0^{+0}_{-0.5}$ mm (${}^{+0}_{-0.0197}$ in) position from cam carrier LH end face

ZD-8AJ



(A) $0 - 0.5$ mm ($0 - 0.0197$ in)

2. Set the intake camshaft LH and the exhaust camshaft LH to the cam carrier LH.

Note:

Apply engine oil to the journals of cam carrier LH before setting the intake camshaft LH and exhaust camshaft LH.

3. Install the front camshaft cap LH, intake center camshaft cap LH, intake rear camshaft cap LH, exhaust center camshaft cap LH and exhaust rear camshaft cap LH.

- (1) Apply liquid gasket to the mating surface of front camshaft cap LH, intake rear camshaft cap LH and exhaust rear camshaft cap LH as shown in the figure.

Caution:

- **Do not apply liquid gasket excessively. Applying excessively may cause excess gasket to flow toward camshaft journal, resulting in engine seizure.**
- **Do not apply liquid gasket excessively to the intake center camshaft cap LH and exhaust center camshaft cap LH.**

Note:

- Before applying liquid gasket, degrease the old liquid gasket seal surface of the front camshaft cap LH, intake rear camshaft cap LH, exhaust rear camshaft cap LH, and cam carrier LH.
- Install within 5 min. after applying liquid gasket.

Preparation items:

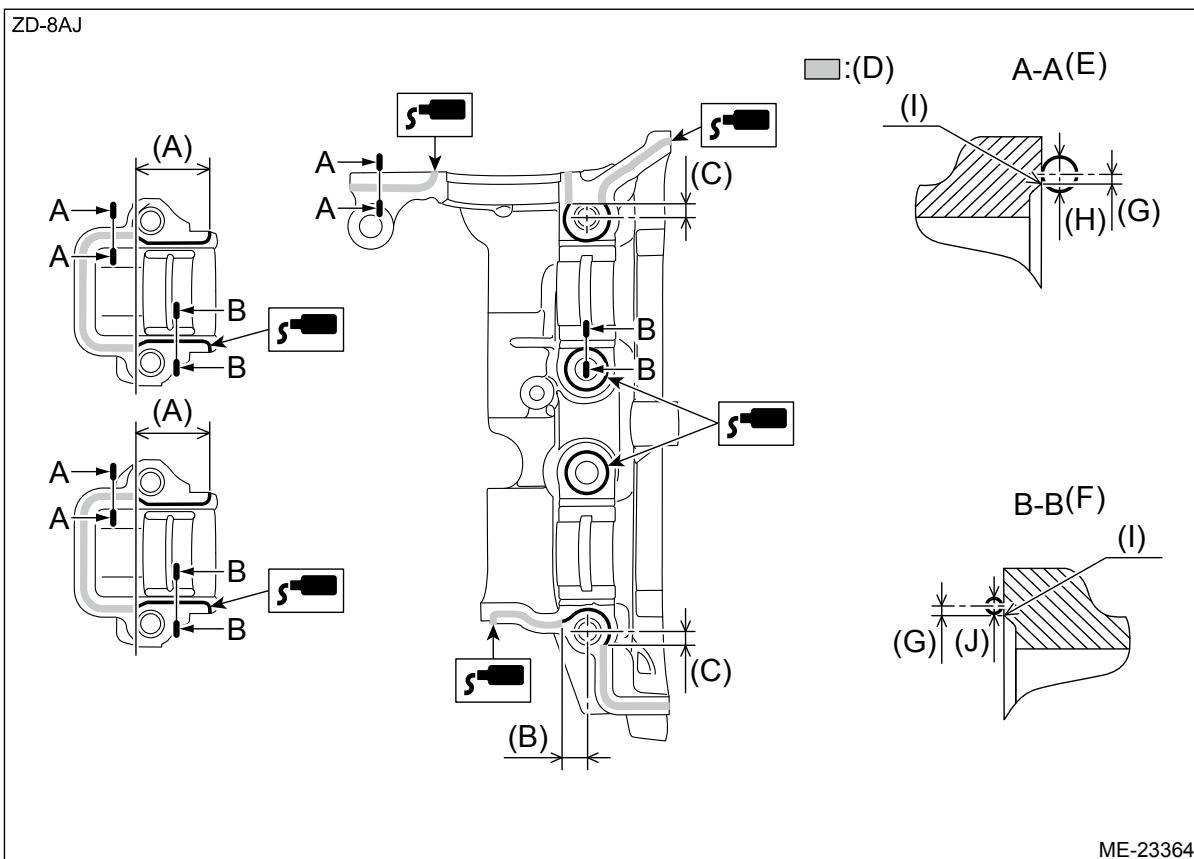
Liquid gasket: THREE BOND 1217G (part No. K0877Y0100), THREE BOND 1217H or equivalent

Liquid gasket applying diameter:**Mating surfaces other than range A**

2 ± 0.5 mm (0.0787 ± 0.0197 in)

Mating surfaces of range A

3 ± 0.5 mm (0.1181 ± 0.0197 in)



(A) 28.5 mm (1.1220 in)

(E) Liquid gasket applying position of mating surfaces of range A

(I) Chamfer edge

(B) 8.5 mm (0.3346 in)

(F) Liquid gasket applying position of mating surfaces other than range A

(J) $\phi2\pm0.5$ mm
(0.0787 ± 0.0197 in)

(C) 5.5 mm (0.2165 in)

(G) Within 1 mm (0.0394 in)

(D) Range A

(H) $\phi3\pm0.5$ mm
(0.1181 ± 0.0197 in)

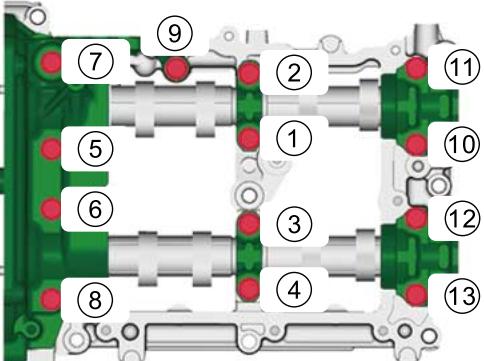
(2) Apply engine oil to the journals of each camshaft cap before setting the camshaft cap.

- (3) Tighten the bolts which secure front camshaft cap LH, intake center camshaft cap LH, intake rear camshaft cap LH, exhaust center camshaft cap LH and exhaust rear camshaft cap LH in numerical order as shown in the figure.

Tightening torque:

18 N·m (1.8 kgf-m, 13.3 ft-lb)

ZD-8AJ



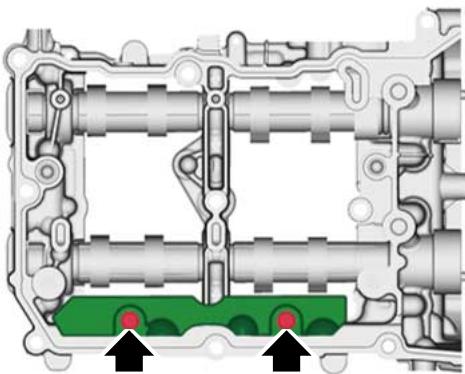
ME-23365

- 4.** Install the oil spacer to the cam carrier LH.

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

ZD-8AJ



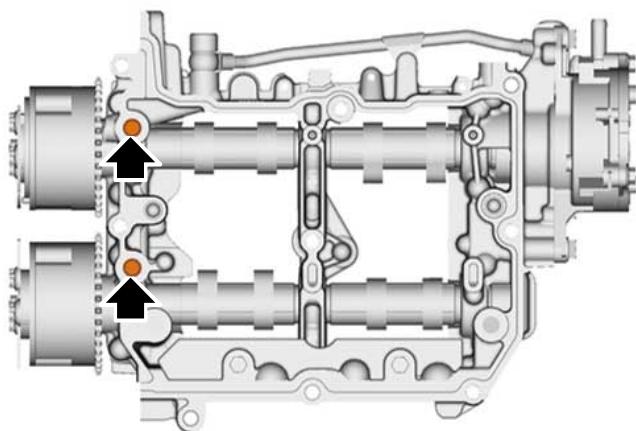
ME-23356

MECHANICAL(H4DO) > Cam Carrier

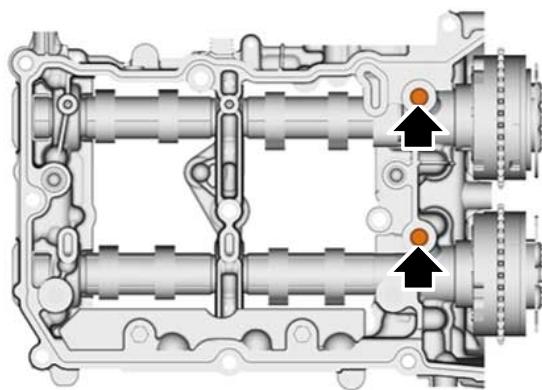
INSPECTION

- 1.** Visually check the cam carrier filter, and if clogging is found, replace it with a new part.

RH



LH



ZD-8AJ

ME-23366

2. Check the camshaft journals for damage and wear. Replace the camshaft if faulty.
3. Check the cam face condition of camshaft, and remove the minor faults by grinding with oil stone. Replace the camshaft if uneven wear is found.
4. Using a dial gauge, check the camshaft bend. If it exceeds the limit, replace the camshaft.

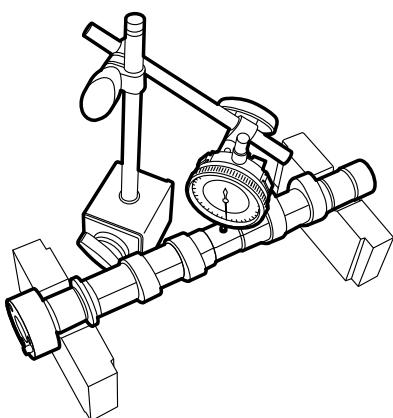
Note:

Measurement should be performed at a temperature of 20°C (68°F).

Camshaft bend:

Limit

0.020 mm (0.0008 in)



ME-23367

5. Check the cam lobe height "H" and cam base circle diameter "D" of camshaft as shown in the figure, using micrometer. If it is not within the standard, replace the camshaft.

Note:

- **Measurement should be performed at a temperature of 20°C (68°F).**
- **Perform measurement of cam lobe height for fuel pump drive section at two points.**

Camshaft cam lobe overall height H:

Intake

Valve drive section

Standard

40.19 — 40.29 mm (1.5823 — 1.5862 in)

Fuel pump drive section**Standard**

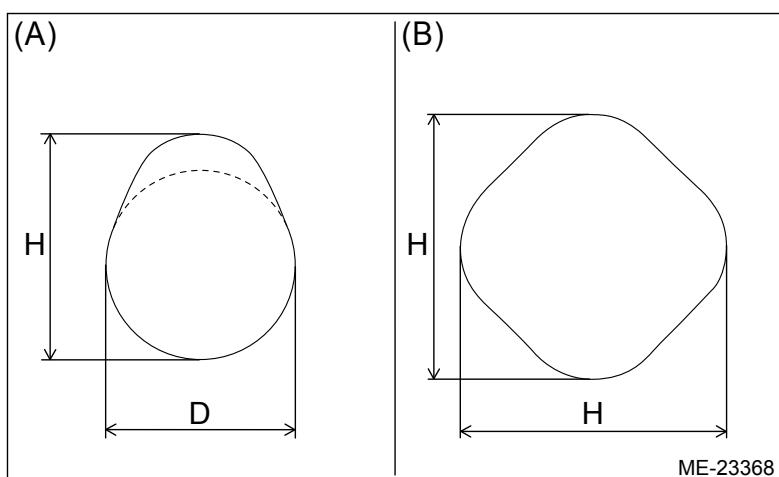
44.94 — 45.06 mm (1.7693 — 1.7740 in)

Exhaust**Standard**

39.51 — 39.61 mm (1.5555 — 1.5594 in)

Camshaft cam base circle diameter D:**Standard**

34.0 mm (1.3386 in)



(A) Valve drive section

(B) Fuel pump drive section

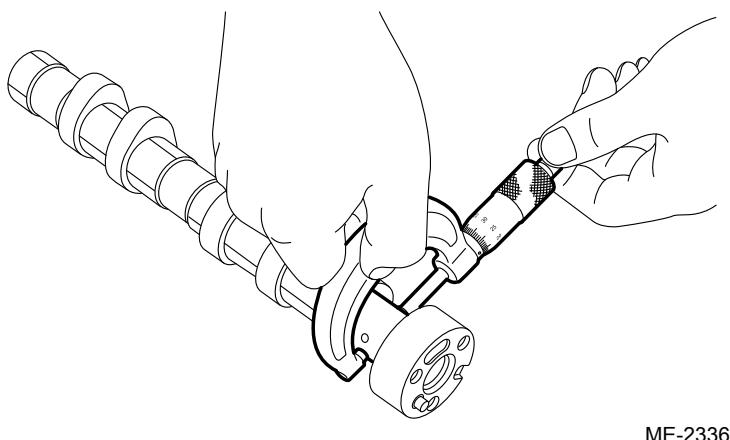
6. Check the camshaft journal outer diameter using micrometer. If it is not within the standard, replace the camshaft.

Note:

- Measurement should be performed at a temperature of 20°C (68°F).
- Measure outer diameter of each journal at several points, and read the value of most worn location.

Camshaft journal outer diameter:**Standard**

25.946 — 25.963 mm (1.0215 — 1.0222 in)



ME-23369

7. Using a dial gauge, check the thrust clearance of the camshaft. If it is not within the standard or if uneven wear is found, replace each camshaft cap and cam carrier as a set. If necessary replace the camshaft.

Note:

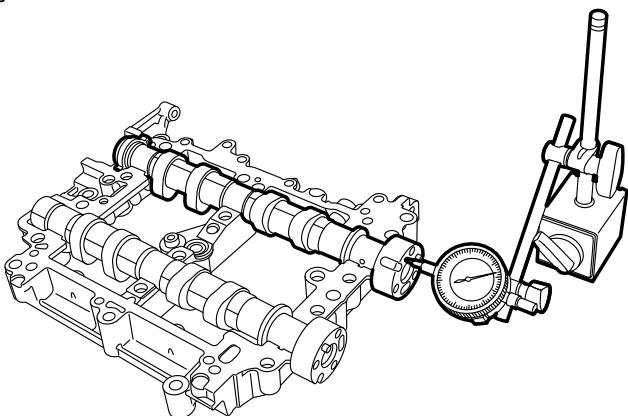
- Measurement should be performed at a temperature of 20°C (68°F).
- Set the dial gauge at end surface of camshaft.

Camshaft thrust clearance:

Standard

0.068 – 0.116 mm (0.0027 – 0.0046 in)

ZD-8AJ



ME-23370

8. Check the oil clearance on the camshaft using a plastigauge.

Note:

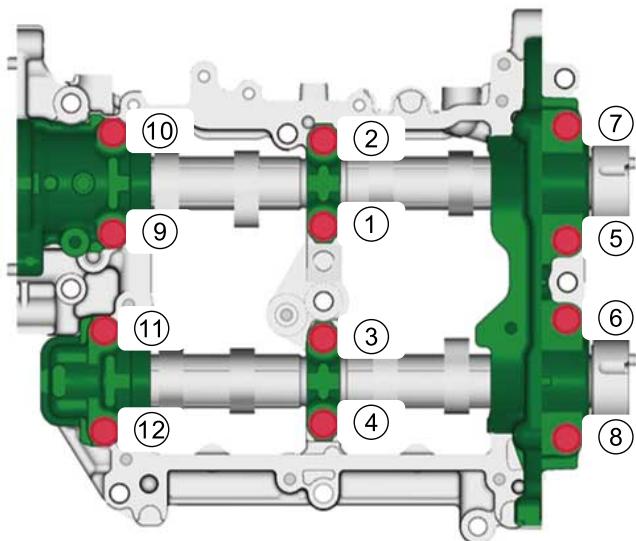
- Measurement should be performed at a temperature of 20°C (68°F).**

- (1) Clean each camshaft cap and cam carrier journals.
- (2) Set the camshaft to the cam carrier.
- (3) Place a plastigauge across the camshaft journals of each camshaft and set the camshaft caps.
- (4) Tighten the bolts which secure front camshaft cap, intake center camshaft cap, intake rear camshaft cap, exhaust center camshaft cap and exhaust rear camshaft cap in numerical order as shown in the figure.

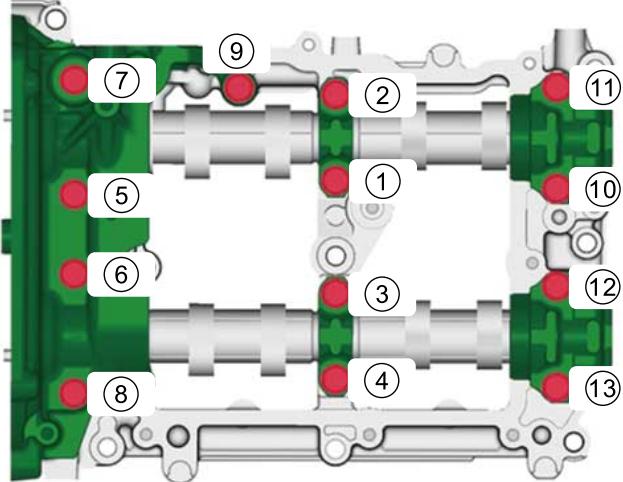
Tightening torque:

18 N·m (1.8 kgf-m, 13.3 ft-lb)

RH

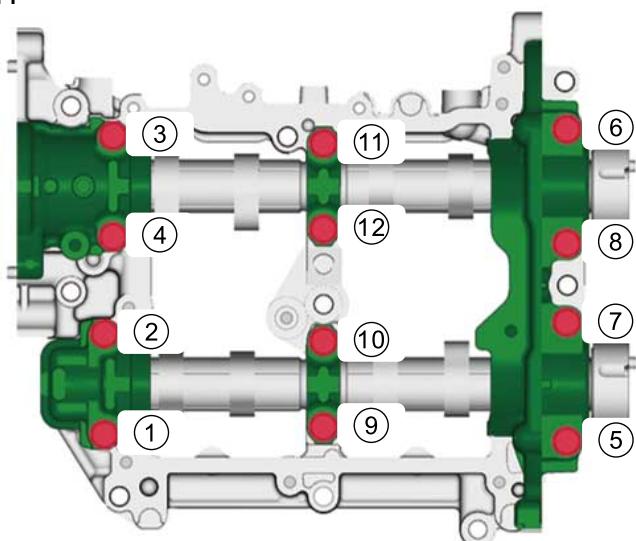


LH

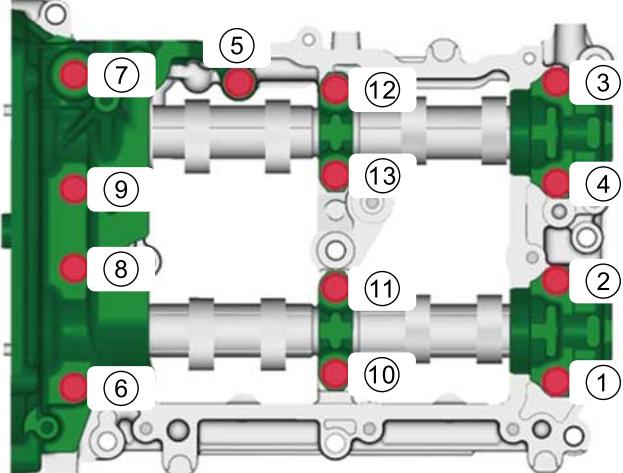


- (5) Loosen the bolts (front camshaft cap, intake center camshaft cap, intake rear camshaft cap, exhaust center camshaft cap and exhaust rear camshaft cap) equally, a little at a time in numerical sequence as shown in the figure, and remove each camshaft cap.

RH



LH



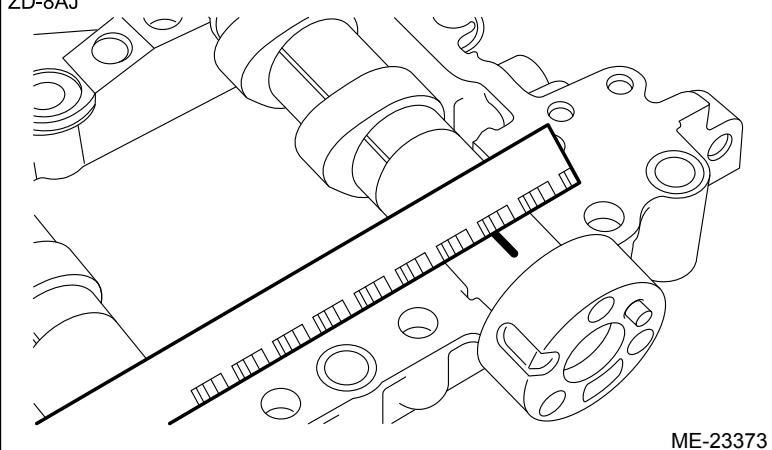
- (6) Determine camshaft oil clearance by matching the widest point of plastigauge on each journal against scale printed on a package of plastigauge. If it is not within the standard, replace each camshaft cap and cam carrier as a set. If necessary replace the camshaft.

Camshaft oil clearance:

Standard

0.037 — 0.072 mm (0.0015 — 0.0028 in)

ZD-8AJ



ME-23373

(7) Completely remove the plastigauge.

MECHANICAL(H4DO) > Cylinder Head

REMOVAL



1. CYLINDER HEAD RH

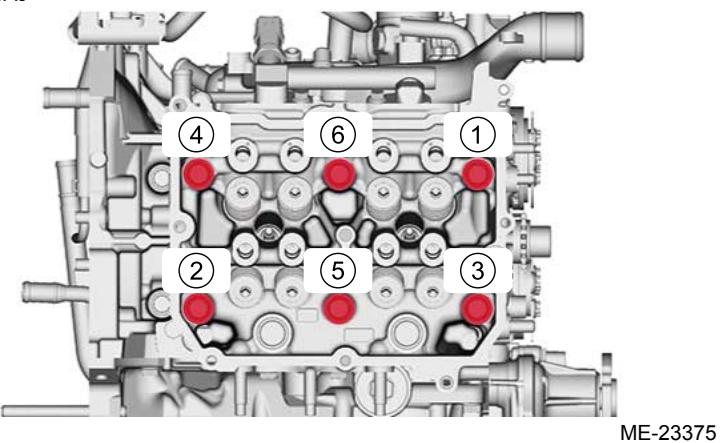
1. Remove the engine unit from the vehicle. [Ref. to MECHANICAL\(H4DO\)>Engine Assembly>REMOVAL.](#)
2. Remove the engine wiring harness. [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>Engine Wiring Harness>REMOVAL.](#)
3. Remove the cam carrier RH. [Ref. to MECHANICAL\(H4DO\)>Cam Carrier>REMOVAL > CAM CARRIER RH.](#)
4. Remove the high-pressure fuel delivery pipe assembly. [Ref. to FUEL INJECTION \(FUEL SYSTEMS\) \(H4DO\)>High Pressure Fuel Delivery Pipe>REMOVAL > HIGH-PRESSURE FUEL DELIVERY PIPE ASSEMBLY.](#)
5. When disassembling the cylinder head RH

Note:

When disassembling the cylinder head RH, perform the following steps also.

- (1) Remove the spark plug #1 and spark plug #3. [Ref. to IGNITION\(H4DO\)>Spark Plug>REMOVAL > RH SIDE.](#)
- (2) Remove the fuel injector RH (cylinder direct injection side). [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>Fuel Injector>REMOVAL>CYLINDER DIRECT INJECTION SIDE>RH.](#)
6. Set the part so that the cylinder head RH is on the upper side.
7. Loosen the bolts securing the cylinder head RH equally, a little at a time in numerical sequence as shown in the figure and remove the cylinder head bolt.

ZD-8AJ



8. While tapping the cylinder head RH with a plastic hammer, separate to remove it from the cylinder block RH.
9. Remove the cylinder head gasket RH.

Caution:

Be careful not to scratch the mating surface of cylinder head and cylinder block.

10. Remove the liquid gasket from the cylinder head RH and cylinder block RH.

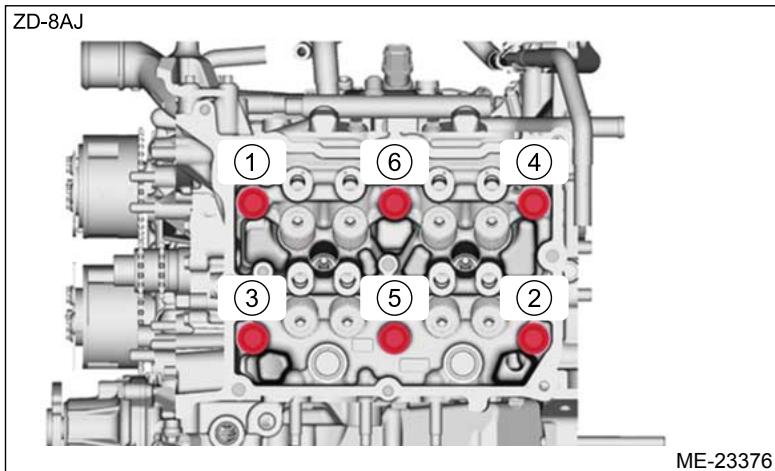
2. CYLINDER HEAD LH

1. Remove the engine unit from the vehicle. [Ref. to MECHANICAL\(H4DO\)>Engine Assembly>REMOVAL.](#)
2. Remove the engine wiring harness. [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>Engine Wiring Harness>REMOVAL.](#)
3. Remove the cam carrier LH. [Ref. to MECHANICAL\(H4DO\)>Cam Carrier>REMOVAL > CAM CARRIER LH.](#)
4. Remove the high-pressure fuel delivery pipe assembly. [Ref. to FUEL INJECTION \(FUEL SYSTEMS\) \(H4DO\)>High Pressure Fuel Delivery Pipe>REMOVAL > HIGH-PRESSURE FUEL DELIVERY PIPE ASSEMBLY.](#)
5. When disassembling the cylinder head LH

Note:

When disassembling the cylinder head LH, perform the following steps also.

- (1) Remove the fuel pipe protector LH No. 3. [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>Fuel Pipe Protector>REMOVAL>FUEL PIPE PROTECTOR LH>FUEL PIPE PROTECTOR LH NO. 3.](#)
- (2) Remove the spark plug #2 and spark plug #4. [Ref. to IGNITION\(H4DO\)>Spark Plug>REMOVAL > LH SIDE.](#)
- (3) Remove the fuel injector LH (cylinder direct injection side). [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>Fuel Injector>REMOVAL>CYLINDER DIRECT INJECTION SIDE>LH.](#)
6. Set the part so that the cylinder head LH is on the upper side.
7. Loosen the bolts securing the cylinder head LH equally, a little at a time in numerical sequence as shown in the figure and remove the cylinder head bolt.



8. While tapping the cylinder head LH with a plastic hammer, separate to remove it from the cylinder block LH.
9. Remove the cylinder head gasket LH.

Caution:

Be careful not to scratch the mating surface of cylinder head and cylinder block.

10. Remove the liquid gasket from cylinder head LH and cylinder block LH.

MECHANICAL(H4DO) > Cylinder Head

INSTALLATION

1. CYLINDER HEAD RH

1. Set the part so that the cylinder block RH is on the upper side.
2. Install the cylinder head RH.

Caution:

Be careful not to scratch the mating surface of cylinder head RH and cylinder block RH.

(1) Clean the bolt holes in the cylinder block RH.

Caution:

To avoid erroneous tightening of the bolts, clean out the bolt holes sufficiently by blowing with compressed air to eliminate engine coolant etc.

(2) Clean the cylinder head bolt threads and apply sufficient engine oil to the washer and cylinder head bolts threads.

(3) Apply liquid gasket to both sides of new cylinder head gasket RH as shown in the figure.

Note:

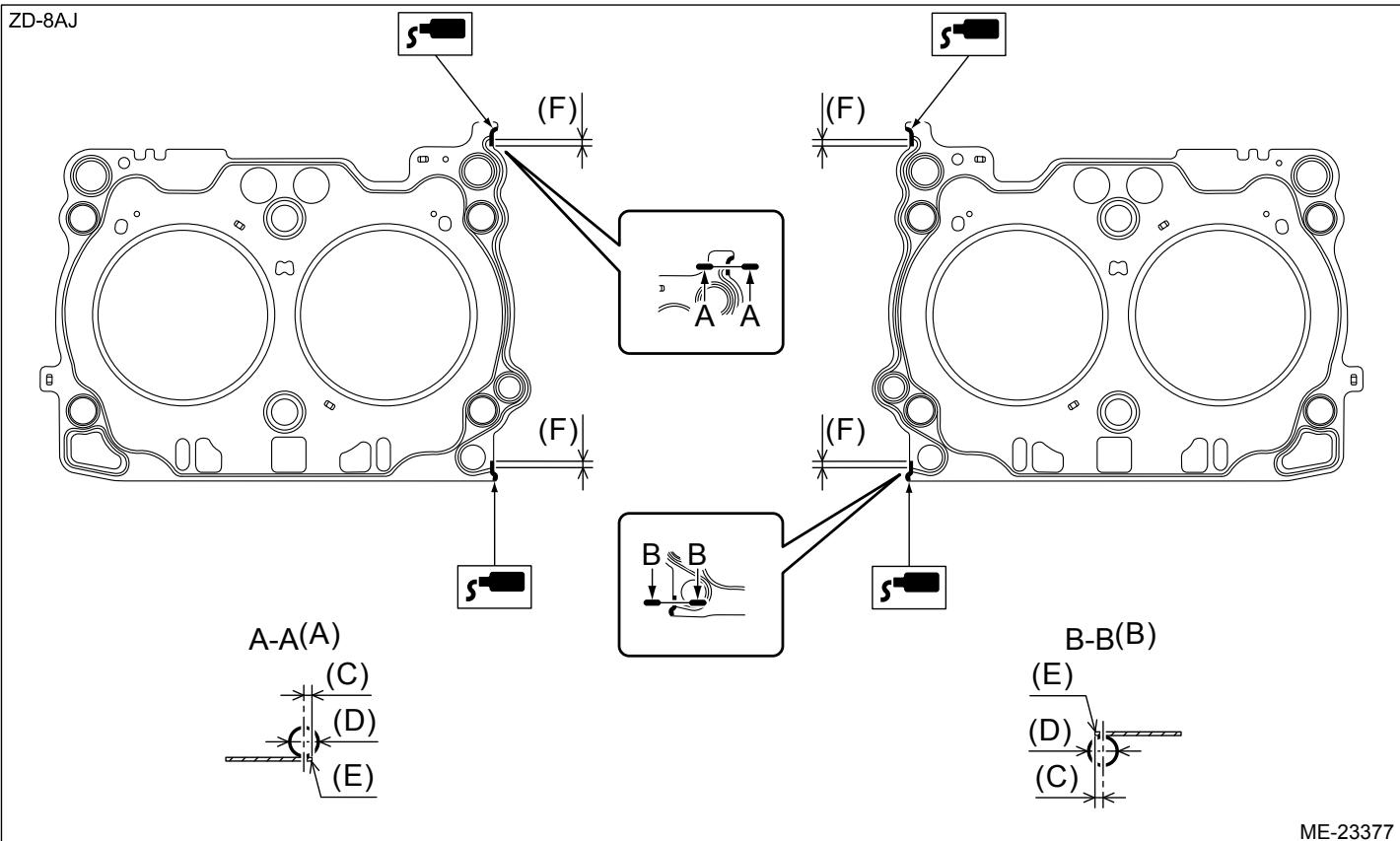
- Before applying liquid gasket, degrease the mating surface of cylinder blocks RH and cylinder head RH.
- Install within 5 min. after applying liquid gasket.

Preparation items:

Liquid gasket: THREE BOND 1217G (part No. K0877Y0100), THREE BOND 1217H or equivalent

Liquid gasket applying diameter:

3 ± 1 mm (0.1181 ± 0.0394 in)



(A) Liquid gasket applying position to the cylinder head side

(C) Within 1 mm (0.0394 in)

(E) Cylinder head gasket edge

(B) Liquid gasket applying position to the cylinder block side

(D) $\varnothing 3\pm1$ mm
(0.1181 ± 0.0394 in)

(F) Overlap margin of bead end and liquid gasket: 3 — 10 mm
(0.1181 — 0.3937 in)

- (4) Attach the cylinder head gasket RH.

Note:

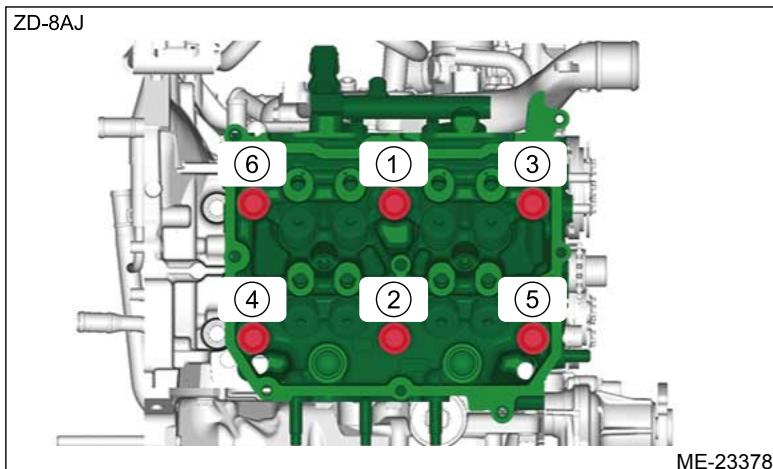
Check that liquid gasket RH is squeezed out from the cylinder head gasket.

- (5) Mount the cylinder head RH onto the cylinder block RH, and tighten all cylinder head bolts with a torque of 20 N·m (2.0 kgf-m, 14.8 ft-lb) in numerical order as shown in the figure.
(6) Tighten all cylinder head bolts further with a torque of 100 N·m (10.2 kgf-m, 73.8 ft-lb) in numerical order as shown in the figure.

Caution:

If the bolt makes stick-slip sound during tightening, repeat the procedure from step (1). In that case, the cylinder head gasket RH can be reused. But it is necessary to remove liquid gasket completely from cylinder block RH, cylinder head RH and cylinder head gasket RH and re-apply to them.

- (7) Loosen all cylinder head bolts by 360° in the reverse order of tightening in step (6).
(8) Tighten all cylinder head bolts with a torque of 20 N·m (2.0 kgf-m, 14.8 ft-lb) in numerical order as shown in the figure.
(9) Tighten all cylinder head bolts with a torque of 42 N·m (4.3 kgf-m, 31.0 ft-lb) in numerical order as shown in the figure.
(10) Using an angle gauge, tighten all cylinder head bolts by 98 — 102 ° in numerical order as shown in the figure.
(11) Using an angle gauge, tighten the cylinder head bolts (2 places) by 98 — 102 ° in the order of 1 → 2 as shown in the figure.
(12) Using an angle gauge, tighten the cylinder head bolts (4 places) by 48 — 52 ° in the order of 3 → 4 → 5 → 6 as shown in the figure.



- 3.** Set the part so that the installation surface of the intake manifold is on the upper side.

- 4.** When the cylinder head RH has been disassembled

Note:

When the cylinder head RH has been disassembled, perform the following steps also.

- (1) Install the fuel injector RH (cylinder direct injection side). [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>Fuel Injector>INSTALLATION>CYLINDER DIRECT INJECTION SIDE>RH.](#)
(2) Install the spark plug #1 and spark plug #3. [Ref. to IGNITION\(H4DO\)>Spark Plug>INSTALLATION > RH SIDE.](#)
5. Install the high-pressure fuel delivery pipe assembly. [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>High Pressure Fuel Delivery Pipe>INSTALLATION > HIGH-PRESSURE FUEL DELIVERY PIPE](#)

ASSEMBLY.

6. Install the cam carrier RH.  [Ref. to MECHANICAL\(H4DO\)>Cam Carrier>INSTALLATION > CAM CARRIER RH.](#)
7. Install the engine wiring harness.  [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>Engine Wiring Harness>INSTALLATION.](#)
8. Install the engine unit to the vehicle.  [Ref. to MECHANICAL\(H4DO\)>Engine Assembly>INSTALLATION.](#)

2. CYLINDER HEAD LH

1. Set the part so that the cylinder block LH is on the upper side.
2. Install the cylinder head LH.

Caution:

Be careful not to scratch the mating surface of cylinder head LH and cylinder block LH.

- (1) Clean the bolt holes in the cylinder block LH.

Caution:

To avoid erroneous tightening of the bolts, clean out the bolt holes sufficiently by blowing with compressed air to eliminate engine coolant etc.

- (2) Clean the cylinder head bolt threads and apply sufficient engine oil to the washer and cylinder head bolts threads.
- (3) Apply liquid gasket to both sides of new cylinder head gasket LH as shown in the figure.

Note:

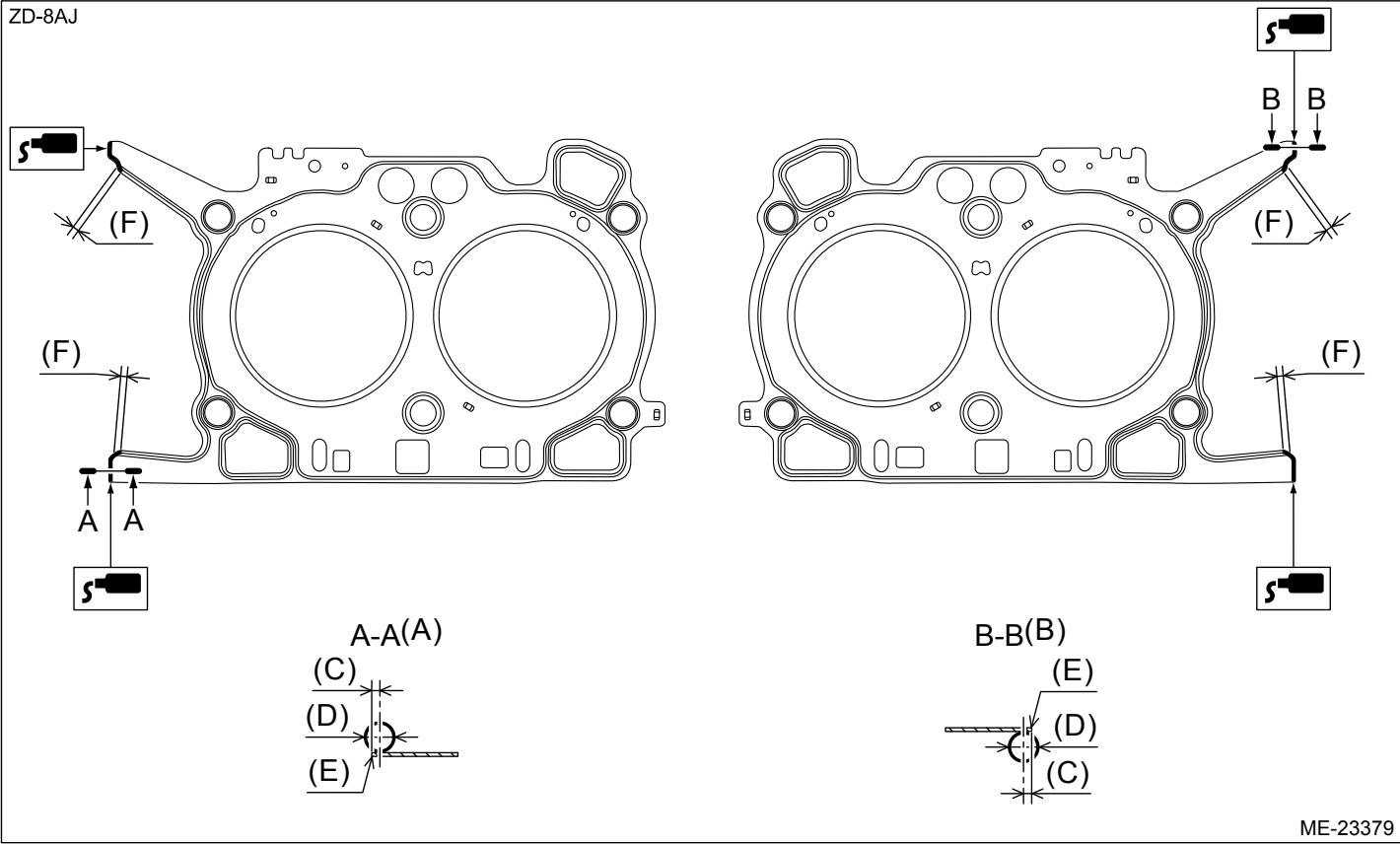
- **Before applying liquid gasket, degrease the mating surface of cylinder blocks LH and cylinder head LH.**
- **Install within 5 min. after applying liquid gasket.**

Preparation items:

Liquid gasket: THREE BOND 1217G (part No. K0877Y0100), THREE BOND 1217H or equivalent

Liquid gasket applying diameter:

3 ± 1 mm (0.1181±0.0394 in)



ME-23379

- | | | |
|--|---|---|
| (A) Liquid gasket applying position to the cylinder head side | (C) Within 1 mm (0.0394 in) | (E) Cylinder head gasket edge |
| (B) Liquid gasket applying position to the cylinder block side | (D) $\phi 3 \pm 1$ mm
$(0.1181 \pm 0.0394$ in) | (F) Overlap margin of bead end and liquid gasket: 3 — 10 mm
$(0.1181 — 0.3937$ in) |

(4) Attach the cylinder head gasket LH.

Note:

Check that liquid gasket is squeezed out from the cylinder head gasket LH.

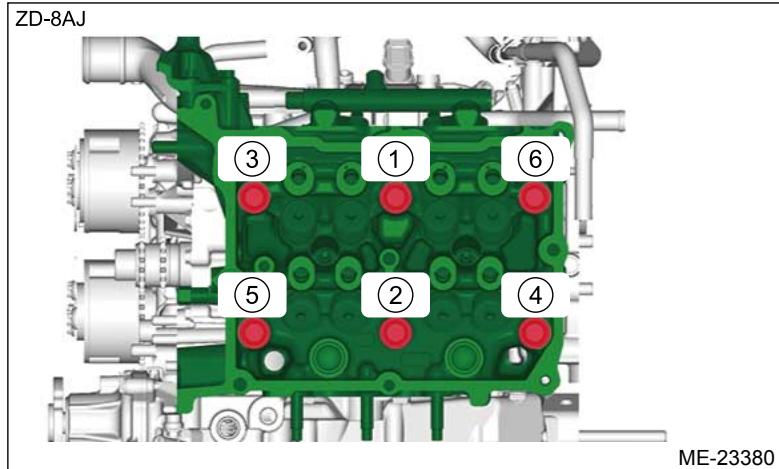
- (5) Mount the cylinder head LH onto the cylinder block LH, and tighten all cylinder head bolts with a torque of 20 N·m (2.0 kgf-m, 14.8 ft-lb) in numerical order as shown in the figure.
- (6) Tighten all cylinder head bolts further with a torque of 100 N·m (10.2 kgf-m, 73.8 ft-lb) in numerical order as shown in the figure.

Caution:

If the bolt makes stick-slip sound during tightening, repeat the procedure from step (1). In that case, the cylinder head gasket LH can be reused. But it is necessary to remove liquid gasket completely from cylinder block LH, cylinder head LH and cylinder head gasket LH and re-apply to them.

- (7) Loosen all cylinder head bolts by 360° in the reverse order of tightening in step (6).
- (8) Tighten all cylinder head bolts with a torque of 20 N·m (2.0 kgf-m, 14.8 ft-lb) in numerical order as shown in the figure.
- (9) Tighten all cylinder head bolts with a torque of 42 N·m (4.3 kgf-m, 31.0 ft-lb) in numerical order as shown in the figure.

- (10) Using an angle gauge, tighten all cylinder head bolts by 98 — 102 ° in numerical order as shown in the figure.
- (11) Using an angle gauge, tighten the cylinder head bolts (2 places) by 98 — 102 ° in the order of 1 → 2 as shown in the figure.
- (12) Using an angle gauge, tighten the cylinder head bolts (4 places) by 48 — 52 ° in the order of 3 → 4 → 5 → 6 as shown in the figure.



- 3.** Set the part so that the installation surface of the intake manifold is on the upper side.
- 4.** When the cylinder head LH has been disassembled

Note:

When the cylinder head LH has been disassembled, perform the following steps also.

- (1) Install the fuel injector LH (cylinder direct injection side). [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>Fuel Injector>INSTALLATION>CYLINDER DIRECT INJECTION SIDE>LH.](#)
- (2) Install the spark plug #2 and spark plug #4. [Ref. to IGNITION\(H4DO\)>Spark Plug>INSTALLATION > LH SIDE.](#)
- (3) Install the fuel pipe protector LH No. 3. [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>Fuel Pipe Protector>INSTALLATION>FUEL PIPE PROTECTOR LH>FUEL PIPE PROTECTOR LH NO. 3.](#)
- 5.** Install the high-pressure fuel delivery pipe assembly. [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>High Pressure Fuel Delivery Pipe>INSTALLATION > HIGH-PRESSURE FUEL DELIVERY PIPE ASSEMBLY.](#)
- 6.** Install the cam carrier LH. [Ref. to MECHANICAL\(H4DO\)>Cam Carrier>INSTALLATION > CAM CARRIER LH.](#)
- 7.** Install the engine wiring harness. [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>Engine Wiring Harness>INSTALLATION.](#)
- 8.** Install the engine unit to the vehicle. [Ref. to MECHANICAL\(H4DO\)>Engine Assembly>INSTALLATION.](#)

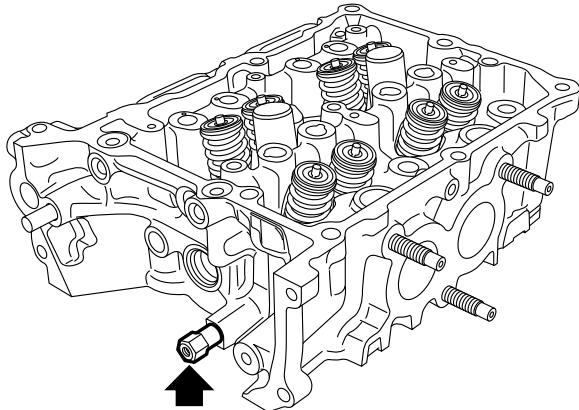
MECHANICAL(H4DO) > Cylinder Head

DISASSEMBLY



- 1.** Remove the chain cover securing bolt from the cylinder head LH.

ZD-8AJ



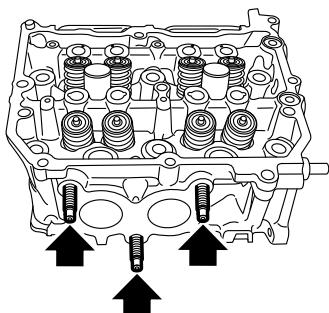
ME-23381

2. Remove the stud bolts from the cylinder head.

Note:

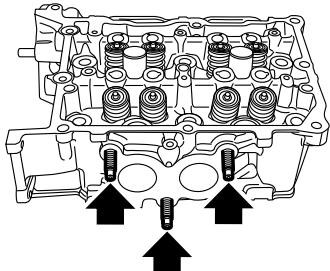
Perform this procedure only when required.

RH



ZD-8AJ

LH



ME-23382

3. Remove the valve collet, valve, valve spring retainer, valve spring and valve spring seat from the cylinder head RH.

Warning:

Metallic sodium is encapsulated in the exhaust valve. Metallic sodium is a strong alkaline material and thus prone to serious chemical reaction. When handling or disposing of the valve, be sure to confirm "DISPOSAL".  [Ref. to MECHANICAL\(H4DO\)>Cylinder Head>DISPOSAL.](#)

Caution:

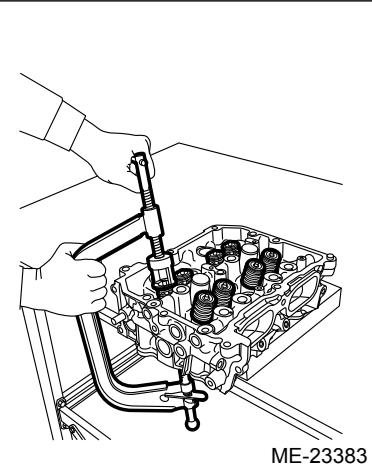
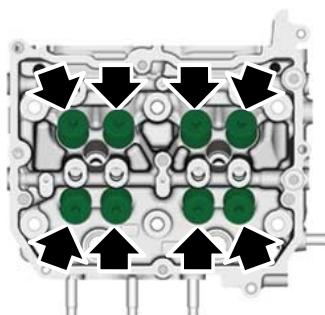
During work, place a waste cloth, etc. to avoid scratching the mating surface of the cylinder head RH.

Note:

- **Mark each part to prevent confusion.**
- **Keep all the removed parts in order for re-installing in their original positions.**

(1) Using valve spring compressor, compress the valve spring and remove the valve collet.

ZD-8AJ



ME-23383

(2) Remove valve, valve spring retainer, valve spring and valve spring seat.

4. Remove the valve collet, valve, valve spring retainer, valve spring and valve spring seat from the cylinder head LH.
5. Remove the valve oil seals from valve guides of cylinder head RH.

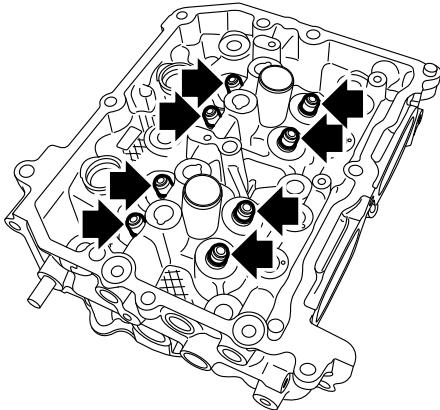
Caution:

- During work, place a waste cloth, etc. to avoid scratching the mating surface of the cylinder head RH.
- Use special care not to damage the cylinder head RH and guide during work.

Note:

For removal of valve guide, refer to INSPECTION. [Ref. to MECHANICAL\(H4DO\)>Cylinder Head>INSPECTION > VALVE & VALVE GUIDE.](#)

ZD-8AJ

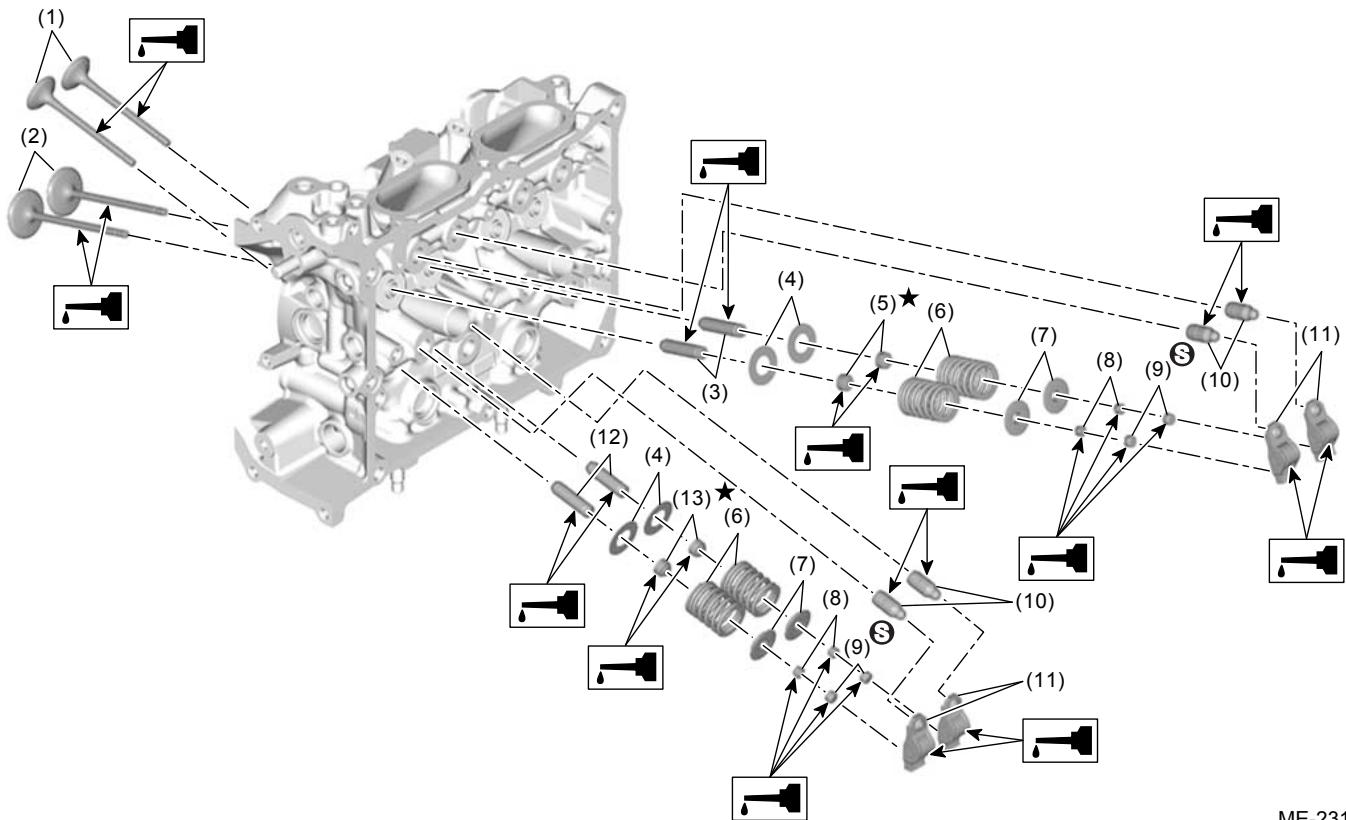


ME-23384

6. For cylinder head LH, remove the valve oil seal in the same manner.

MECHANICAL(H4DO) > Cylinder Head

ASSEMBLY



ME-23184

- | | | |
|---------------------------|------------------------------|-----------------------------|
| (1) Exhaust valve | (6) Valve spring | (11) Roller rocker arm |
| (2) Intake valve | (7) Valve spring retainer | (12) Exhaust valve guide |
| (3) Intake valve guide | (8) Valve collet | (13) Exhaust valve oil seal |
| (4) Valve spring seat | (9) Valve shim | |
| (5) Intake valve oil seal | (10) Roller rocker arm pivot | |

1. Using the ST, install new valve oil seals to valve guides of cylinder head RH.

Caution:

- During work, place a waste cloth, etc. to avoid scratching the mating surface of the cylinder head RH.
- Use special care not to damage the cylinder head RH and guide during work.
- When installing the valve oil seal, press the ST with hands to install it and never drive the ST with a plastic hammer, otherwise the valve oil seal can be damaged.

Note:

- Apply engine oil to valve oil seal before installing.
- The intake valve oil seals and exhaust valve oil seals are distinguished by their colors.

Identification colors:

Intake [Gray]

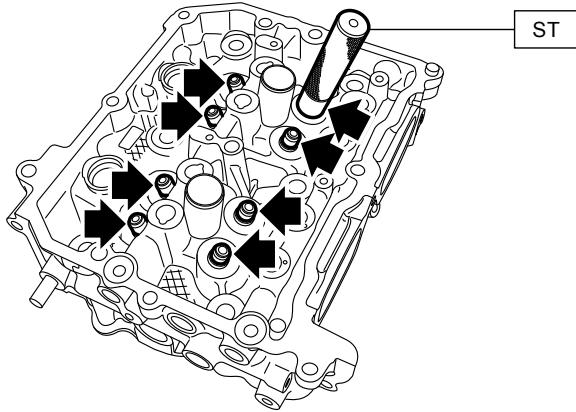
Exhaust [Light green]

- For installation of valve guide, refer to INSPECTION. [Ref. to MECHANICAL\(H4DO\)>Cylinder Head>INSPECTION > VALVE & VALVE GUIDE.](#)

Preparation tool:

ST: VALVE OIL SEAL GUIDE (18261AA010)

ZD-8AJ



2. For cylinder head LH, install the valve oil seal in the same manner.
3. Install the valve spring seat, valve spring, valve spring retainer, valve and valve collet to the cylinder head RH.

Caution:

During work, place a waste cloth, etc. to avoid scratching the mating surface of the cylinder head RH.

- (1) Set the valve spring seat, valve spring and valve spring retainer onto the cylinder head RH.

Note:

Be sure to install the valve spring with its close-coiled end facing the cylinder head side.

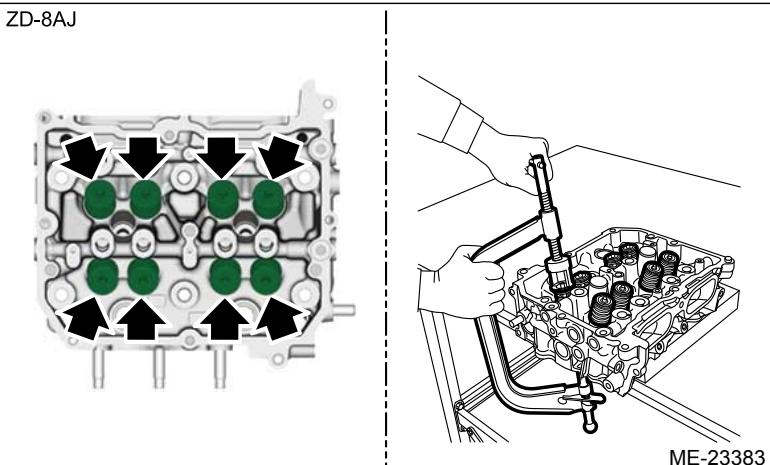
- (2) Coat the valve stem of each valve with engine oil and insert the valve into valve guide.

Note:

When inserting the valve into valve guide, use special care not to damage the oil seal lip.

- (3) Using valve spring compressor, compress the valve spring and install the valve collet.

ZD-8AJ

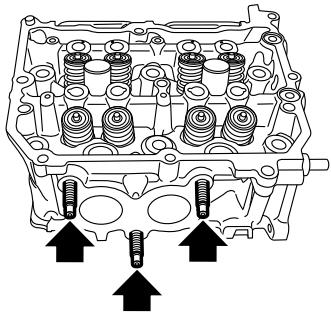


4. Install the valve spring seat, valve spring, valve spring retainer, valve and valve collet to the cylinder head LH.
5. Lightly tap the valve spring retainer with a plastic hammer, and make sure that the valve collet is securely attached.
6. Install the stud bolts onto cylinder heads.

Tightening torque:

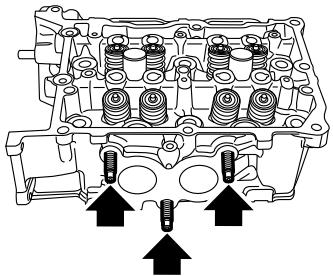
18 N·m (1.8 kgf-m, 13.3 ft-lb)

RH



ZD-8AJ

LH



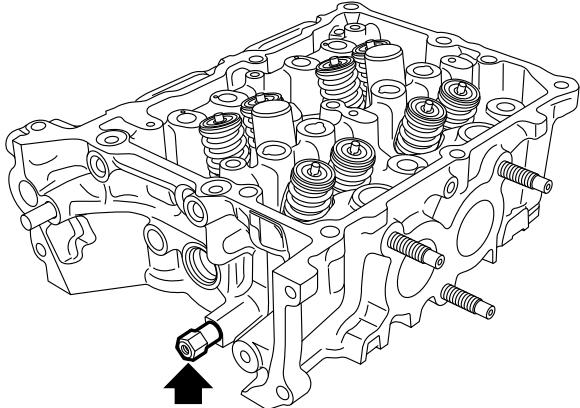
ME-23382

7. Install the chain cover securing bolt to the cylinder head LH.

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

ZD-8AJ



ME-23381

MECHANICAL(H4DO) > Cylinder Head

INSPECTION

1. CYLINDER HEAD

1. Visually inspect to make sure that there are no cracks, scratches or other damage.
2. Use liquid penetrant tester on the important sections to check for fissures.
3. Check that there are no marks of gas leaking or water leaking on gasket attachment surface.
4. Check the warping of the cylinder head mating surface that mates with cylinder block at the locations shown in the figure using a straight edge (A) and thickness gauge (B). If it exceeds the limit, correct the surface by grinding it with a surface grinder or replace the cylinder head.

Note:

- Measurement should be performed at a temperature of 20°C (68°F).
- If there is warpage on the cylinder head mating surface, the cylinder head bolt tightening torque and angle tightening may be improper. When installing the cylinder head, make sure that tightening torque and angle tightening work is performed precisely according to the operation procedures.
- When the cylinder head is replaced, lap each valve. Refer to "VALVE SEAT" for lapping. 
[Ref. to MECHANICAL\(H4DO\)>Cylinder Head>INSPECTION > VALVE SEAT.](#)

Cylinder head warpage:

Limit

0.020 mm (0.0008 in)

Cylinder head grinding limit:

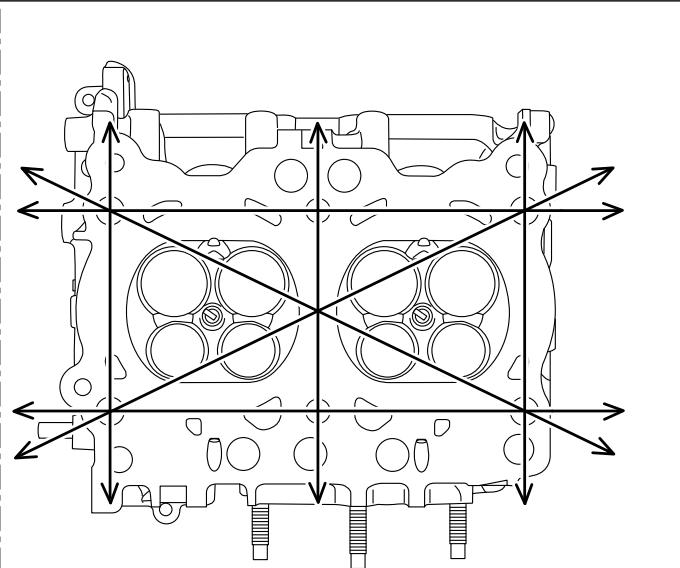
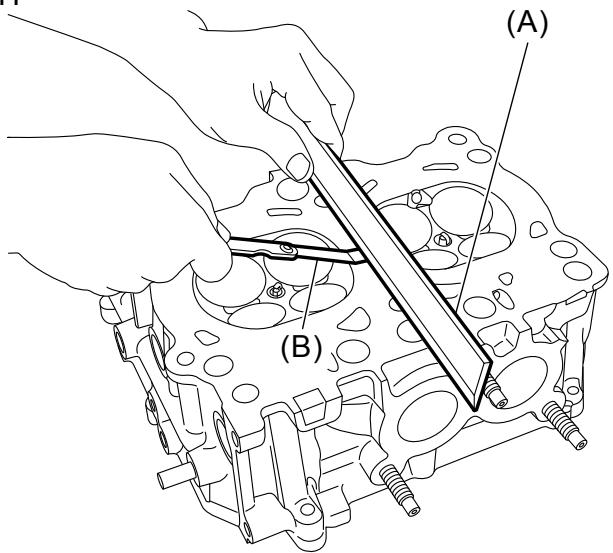
98.45 mm (3.8760 in) or less

Cylinder head height:

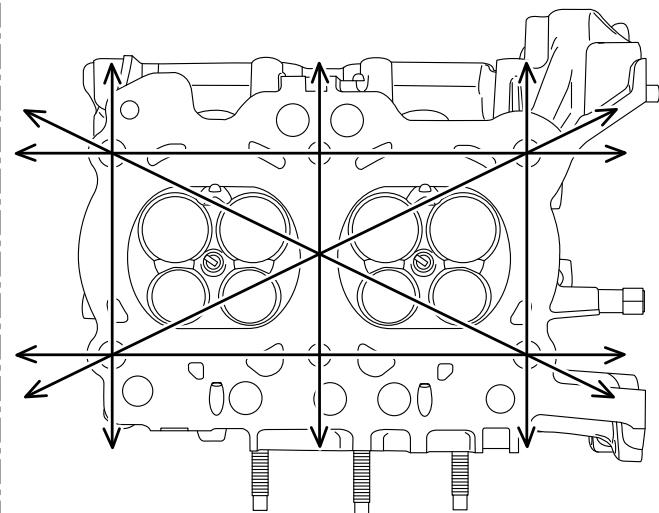
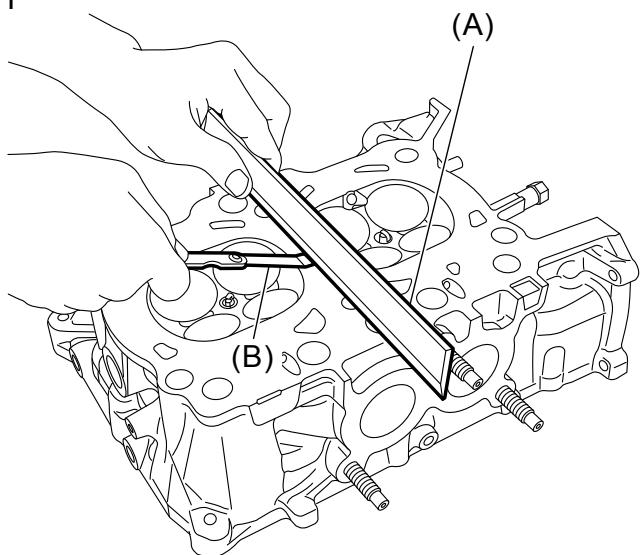
Standard

98.5 mm (3.8779 in)

RH



LH



ZD-8AJ

ME-23386

2. VALVE & VALVE GUIDE

Warning:

Metallic sodium is encapsulated in the exhaust valve. Metallic sodium is a strong alkaline material and thus prone to serious chemical reaction. When handling or disposing of the valve, be sure to confirm "DISPOSAL".  Ref. to MECHANICAL(H4DO)>Cylinder Head>DISPOSAL.

1. Check the valve flange and stem for damage, wear or deformation.
2. Measure the thickness "T" of valve head edge as shown in the figure using a caliper gauge. If it is not within the standard, replace the valve.

Note:

- It is possible to differentiate between the intake valve and the exhaust valve by their overall length.

Valve overall length:**Intake**

104.95 mm (4.1319 in)

Exhaust

96.53 mm (3.8004 in)

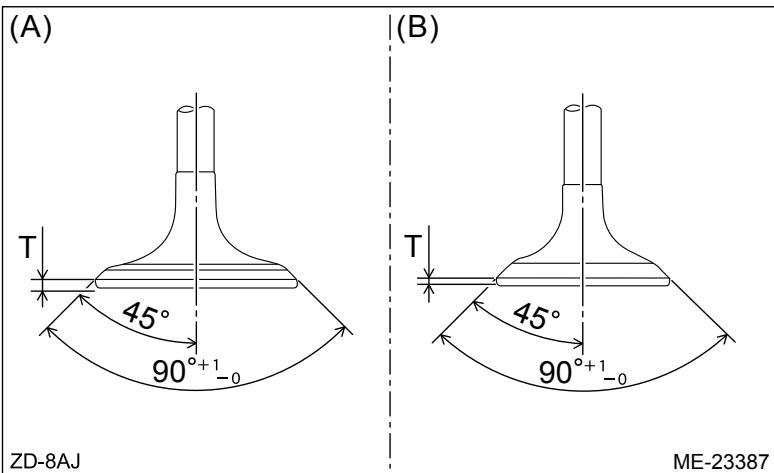
- When the valve is replaced, lap the valve. Refer to "VALVE SEAT" for lapping.  [Ref. to MECHANICAL\(H4DO\)>Cylinder Head>INSPECTION > VALVE SEAT.](#)

Valve head edge thickness T:**Intake (A)****Standard**

0.8 — 1.2 mm (0.0315 — 0.0472 in)

Exhaust (B)**Standard**

1.0 — 1.4 mm (0.0394 — 0.0551 in)



3. Check the clearance between valve and valve guide. Check the clearance between valve and valve guide by measuring the outer diameter of valve stem and the inner diameter of valve guide respectively.

- (1) Measure the outer diameter of valve stem with a micrometer. If it is not within the standard, replace the valve.

Note:

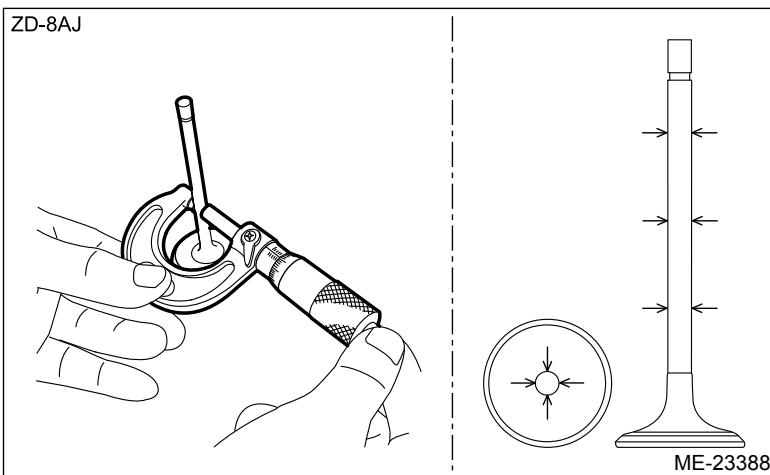
- Measurement should be performed at a temperature of 20°C (68°F).
- Measure the outer diameter of the valve stem at the six locations as shown in the figure, and read the value of most worn location.
- When the valve is replaced, lap the valve. Refer to "VALVE SEAT" for lapping.  [Ref. to MECHANICAL\(H4DO\)>Cylinder Head>INSPECTION > VALVE SEAT.](#)

Valve stem outer diameter:**Intake****Standard**

5.455 — 5.470 mm (0.2148 — 0.2154 in)

Exhaust**Standard**

5.445 — 5.460 mm (0.2144 — 0.2150 in)



- (2) Using a caliper gauge, measure the inner diameter of valve guide. If it is not within the standard, replace the valve guide. For replacement procedure, refer to step 4.

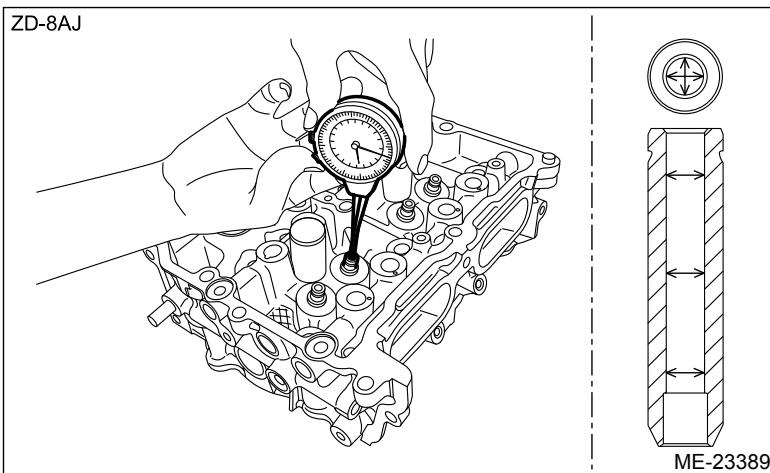
Note:

- Measurement should be performed at a temperature of 20°C (68°F).
- Measure the inner diameter of the valve guide at the six locations as shown in the figure, and read the value of most worn location.

Valve guide inner diameter:

Standard

5.500 — 5.512 mm (0.2165 — 0.2170 in)



- (3) Calculate the clearance between valve and valve guide.

Clearance between valve and valve guide:

Intake

Standard

0.030 — 0.057 mm (0.0012 — 0.0022 in)

Exhaust

Standard

0.040 — 0.067 mm (0.0016 — 0.0026 in)

- 4.** If the clearance between valve and valve guide exceeds the standard, replace the valve or valve guide, whichever shows the greater amount of wear or damage. For replacement procedure of valve guide, refer to the following.

Note:

When the valve is replaced, lap the valve. Refer to "VALVE SEAT" for lapping.  [**Ref. to MECHANICAL\(H4DO\)>Cylinder Head>INSPECTION > VALVE SEAT.**](#)

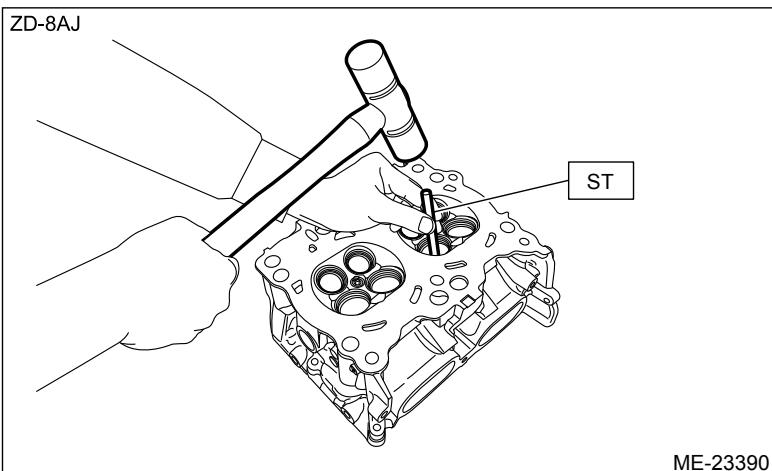
- (1) Insert ST into the valve guide with the combustion chamber upward and remove the valve guide using plastic hammer.

Caution:

- Place a wood board wrapped with a waste cloth to stabilize the cylinder head before work.
- Use special care not to damage the cylinder head during work.
- Always strike the ST vertically with a plastic hammer. Otherwise, the ST can be damaged.

Preparation tool:

ST: VALVE GUIDE REMOVER AND INSTALLER (499765700)



- (2) Before installing the valve guide, make sure that neither scratches nor damages exist on the inner surface of valve guide installation holes of cylinder head.
(3) Draw a reference line (A) used for insertion on the valve guide using a marker as shown in the figure.

Note:

A reference line for insert is used as a guide when tapping-in the valve guide.

Valve guide inserting reference line position L:

Intake

Standard

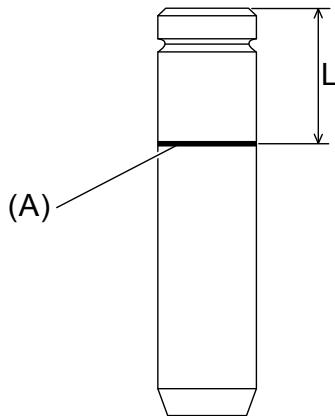
15 mm (0.5906 in)

Exhaust

Standard

12 mm (0.4724 in)

ZD-8AJ



ME-23391

- (4) Apply an enough coat of engine oil to the valve guide, and set the valve guide on the cylinder head with the combustion chamber downward.
- (5) Insert the ST into the valve guide, and tap-in the valve guide to the reference line (A) for insert using plastic hammer.

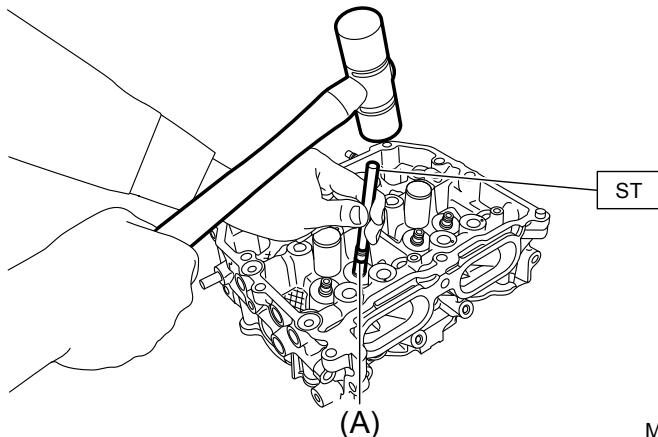
Caution:

- During work, place a waste cloth, etc. to avoid scratching the mating surface of the cylinder head.
- Use special care not to damage the cylinder head during work.
- Always strike the ST vertically with a plastic hammer. Otherwise, the ST can be damaged.

Preparation tool:

ST: VALVE GUIDE REMOVER AND INSTALLER (499765700)

ZD-8AJ



ME-23392

- (6) Measure the valve guide protrusion amount "Q" as shown in the figure using a caliper gauge. Insert the ST into the valve guide again, and tap-in the valve guide so that it is positioned within standard by referring to the measured value using plastic hammer.

Caution:

- During work, place a waste cloth, etc. to avoid scratching the mating surface of the cylinder head.
- Use special care not to damage the cylinder head during work.
- Always strike the ST vertically with a plastic hammer. Otherwise, the ST can be damaged.

Note:

**Be careful not to tap-in excessively by repeating the steps of Tapping-in → Measurement
→ Tapping-in → Measurement ... when installing the valve guide.**

Preparation tool:

ST: VALVE GUIDE REMOVER AND INSTALLER (499765700)

Valve guide protrusion amount Q:

Intake

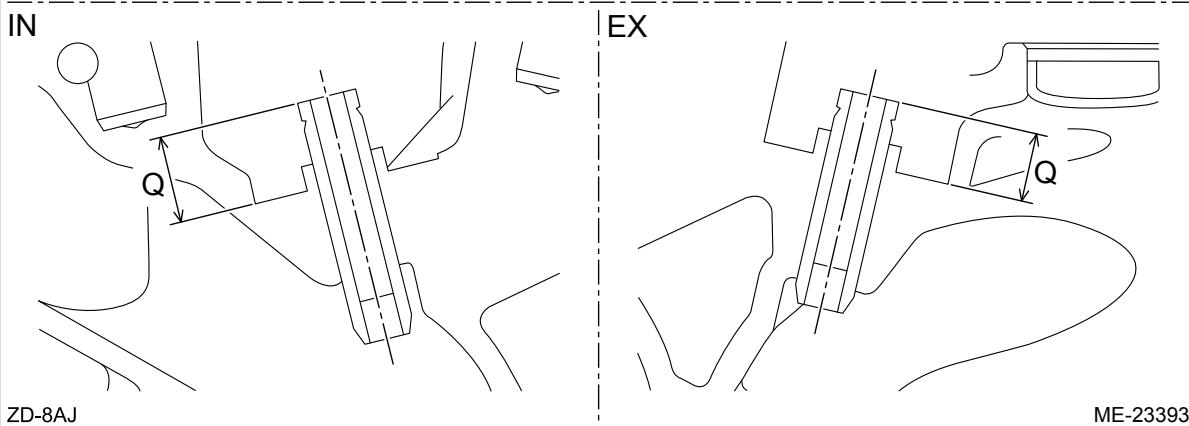
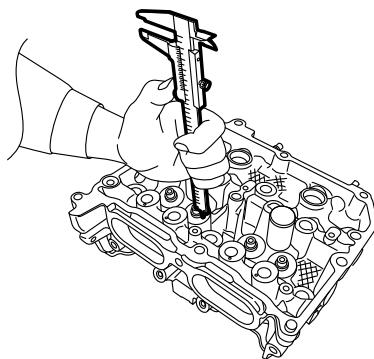
Standard

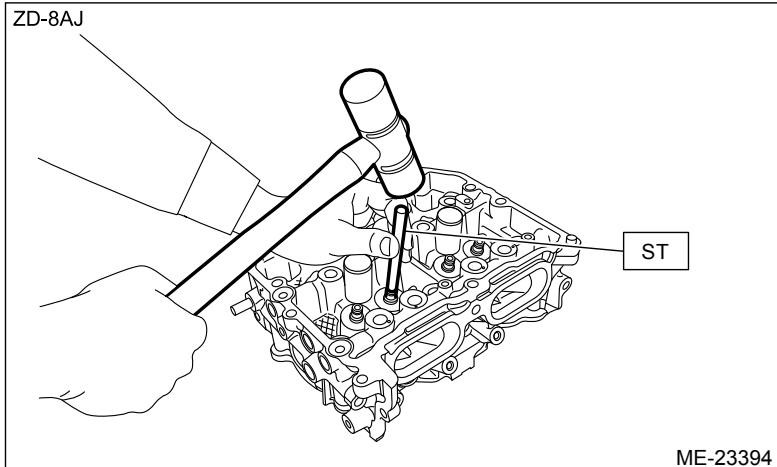
14.6 — 15.0 mm (0.5748 — 0.5906 in)

Exhaust

Standard

11.6 — 12.0 mm (0.4567 — 0.4724 in)





(7) Ream the inside of valve guide with the combustion chamber upward using the ST. Put the ST in valve guide, and rotate the ST slowly clockwise while pushing it lightly. Bring the ST back while rotating it clockwise.

Caution:

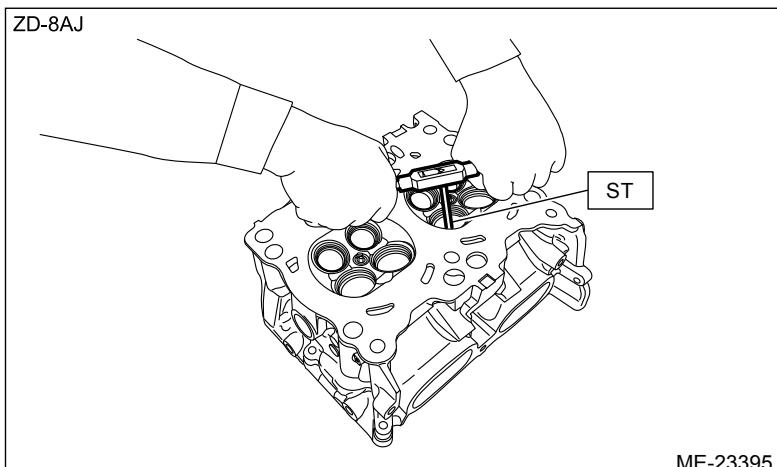
- Place a wood board wrapped with a waste cloth to stabilize the cylinder head before work.
- Use special care not to damage the cylinder head during work.

Note:

- Apply engine oil to the ST.
- If the inner surface of valve guide is damaged, the edge of ST should be slightly ground with oil stone.
- If the inner surface of valve guide becomes lustrous and the ST does not chip, use a new ST or remedy the ST.

Preparation tool:

ST: VALVE GUIDE REAMER (499765900)



(8) After reaming, clean the valve guide to remove chips.

(9) Check the seating width between valve and valve seat. [Ref. to MECHANICAL\(H4DO\)>Cylinder Head>INSPECTION > VALVE SEAT.](#)

3. VALVE & VALVE SHIM

Warning:

Metallic sodium is encapsulated in the exhaust valve. Metallic sodium is a strong alkaline material and thus prone to serious chemical reaction. When handling or disposing of the valve, be sure to confirm "DISPOSAL".  [Ref. to MECHANICAL\(H4DO\)>Cylinder Head>DISPOSAL.](#)

1. Visually check the valve shim for damage.
2. Check the clearance between valve and valve shim. Check the clearance between valve and valve shim by measuring the outer diameter of valve stem end and the inner diameter of valve shim respectively.
 - (1) Measure the outer diameter of valve stem end with a micrometer. If it is not within the standard, replace the valve.

Note:

- Measurement should be performed at a temperature of 20°C (68°F).
- Measure the outer diameter of the valve stem end at the two locations as shown in the figure, and read the value of most worn location.
- When the valve is replaced, lap the valve. Refer to "VALVE SEAT" for lapping.  [Ref. to MECHANICAL\(H4DO\)>Cylinder Head>INSPECTION > VALVE SEAT.](#)

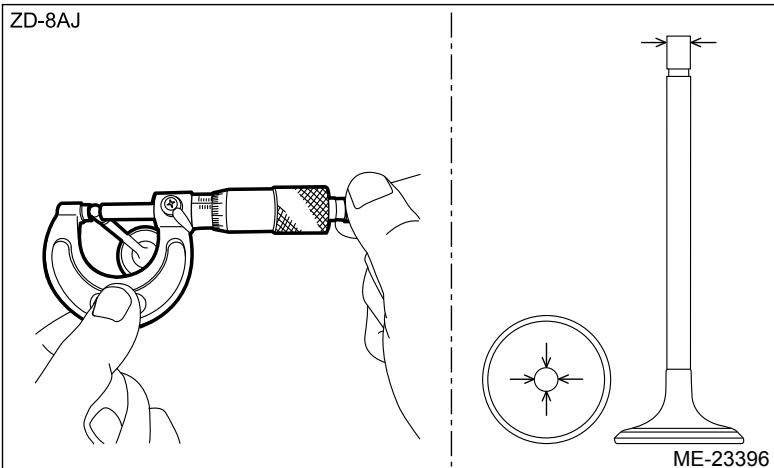
Valve stem end outer diameter:**Intake****Standard**

5.455 – 5.470 mm (0.2148 – 0.2154 in)

Exhaust**Standard**

5.445 – 5.460 mm (0.2144 – 0.2150 in)

ZD-8AJ



- (2) Using a caliper gauge, measure the inner diameter of valve shim. If it is not within the standard, replace the valve shim.

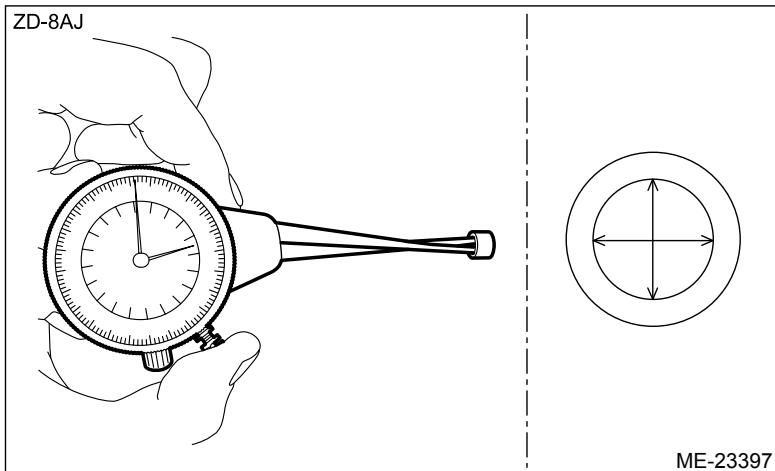
Note:

- Measurement should be performed at a temperature of 20°C (68°F).
- Measure the inner diameter of the valve shim at the two locations as shown in the figure, and read the value of most worn location.
- If the valve shim has to be replaced, check the cam clearance and replace with the suitable valve shim.  [Ref. to MECHANICAL\(H4DO\)>Cam Clearance>INSPECTION > WHEN TIMING CHAIN ASSEMBLY IS REMOVED.](#)

Valve shim inner diameter:

Standard

5.500 — 5.560 mm (0.2165 — 0.2189 in)



- (3) Calculate the clearance between valve and valve shim. If the clearance exceeds the standard, replace the valve or valve shim, whichever shows the greater amount of wear or damage.

Note:

- When the valve is replaced, lap the valve. Refer to "VALVE SEAT" for lapping. [Ref. to MECHANICAL\(H4DO\)>Cylinder Head>INSPECTION > VALVE SEAT.](#)
- If the valve shim has to be replaced, check the cam clearance and replace with the suitable valve shim. [Ref. to MECHANICAL\(H4DO\)>Cam Clearance>INSPECTION > WHEN TIMING CHAIN ASSEMBLY IS REMOVED.](#)

Clearance between valve and valve shim:

Intake

Standard

0.030 — 0.105 mm (0.0012 — 0.0041 in)

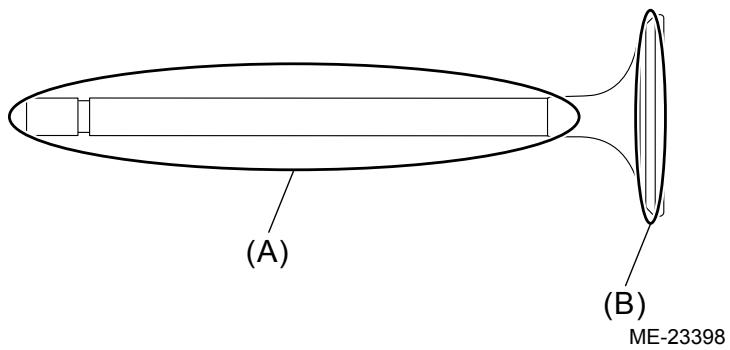
Exhaust

Standard

0.040 — 0.115 mm (0.0016 — 0.0045 in)

4. VALVE SEAT

1. Check the valve seat for damage and deformation.
2. Check the seating width and seating position between valve and valve seat for the intake valve seat and exhaust valve seat.
 - (1) Clean the valve and valve seat.
 - (2) Coat the stem (A) of the valve lightly with engine oil and apply red dye evenly on the valve face (B).



- (3) Using the valve lapper, slowly insert the valve with red dye applied into the valve guide. Lightly press the valve against the valve seat without turning the valve, and then slowly pull out the valve.
- (4) Check the seating width "W" of valve seat as shown in the figure, using a caliper gauge. Check the seating width "W" between valve and valve seat by measuring the width of red dye on the seating surface of valve seat. If the seating width "W" between valve and valve seat is out of the standard, correct the seating surface of valve seat using the valve seat cutter. For correcting procedures of the valve seat seating surface, refer to step 3.

Note:

- When the red dye does not appear seamlessly on the valve seat seating surface, lap the valve. For lapping procedure, refer to step 4.
- When the red dye does not appear seamlessly on the valve seat seating surface even after lapping the valve, correct the valve seat seating surface using the valve seat cutter. For correcting procedures of the valve seat seating surface, refer to step 3.

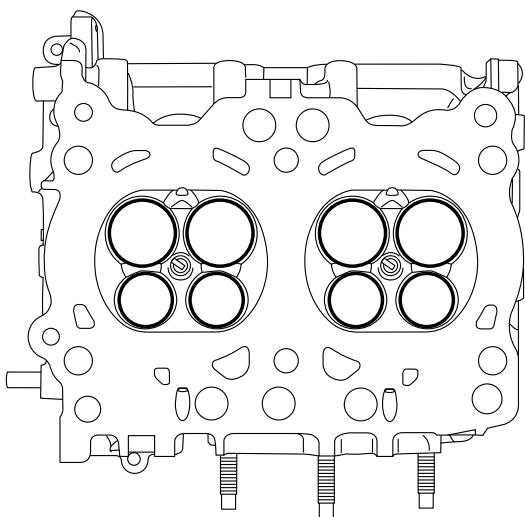
Seating width W between valve and valve seat:**Intake****Standard**

0.8 — 1.6 mm (0.0315 — 0.0630 in)

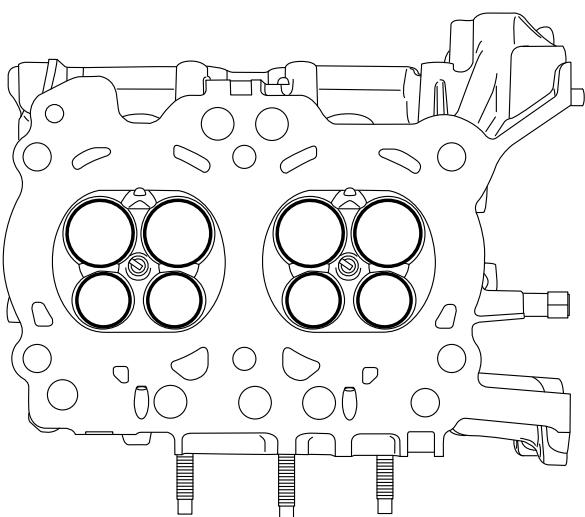
Exhaust**Standard**

1.1 — 1.7 mm (0.0433 — 0.0669 in)

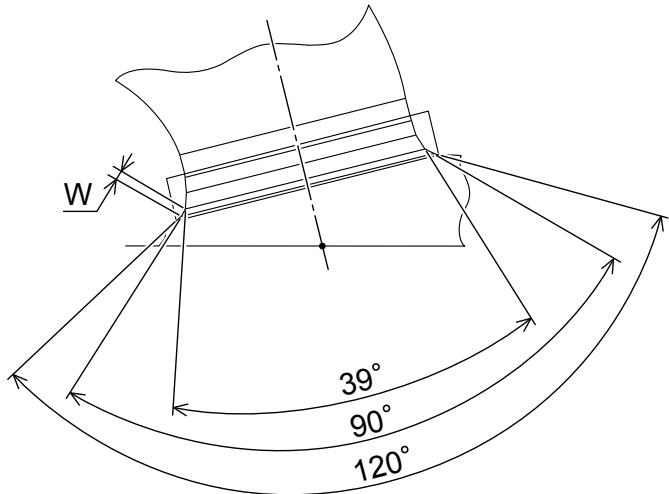
RH



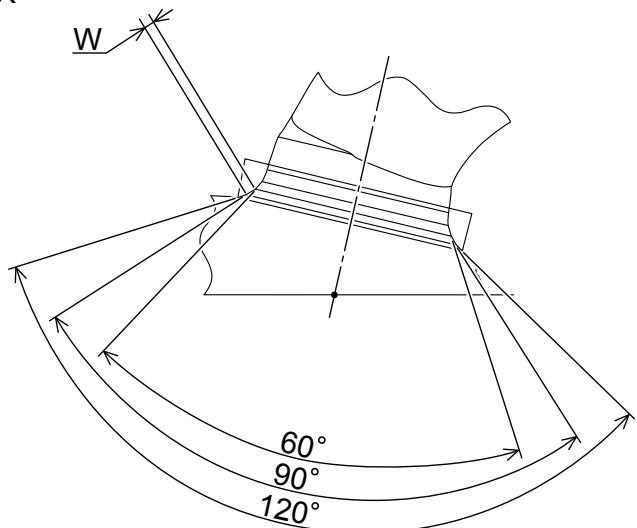
LH



IN



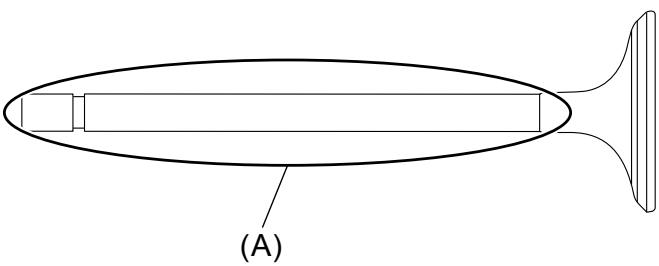
EX



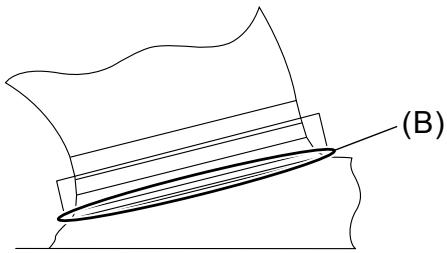
ZD-8AJ

ME-23403

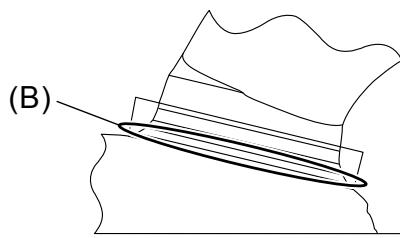
- (5) Wipe off the red dye on the valve and valve seat completely.
- (6) Coat the stem (A) of the valve lightly with engine oil and apply red dye evenly on the seating surface (B) between valve and valve seat.



IN



EX



ZD-8AJ

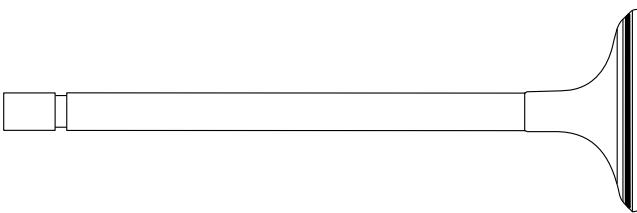
ME-23404

- (7) Using the valve lapper, slowly insert the valve into the valve guide. Lightly press the valve against the valve seat without turning the valve, and then slowly pull out the valve.
- (8) Check the seating position between valve and valve seat. Check the seating position between valve and valve seat by checking the position of red dye on the valve face. If the seating position between valve and valve seat is not at the center of valve face, correct the seating surface of valve seat using the valve seat cutter. For correcting procedures of the valve seat seating surface, refer to step 3.

Seating position between valve and valve seat:

Valve face center

ZD-8AJ



ME-23405

- (9) After inspection, wipe off the red dye completely.

3. When correcting the seating surfaces of valve seat

- (1) Correct the seating angle between valve and valve seat using the 45° valve seat cutter.

Note:

- Select the size of the valve seat cutter by referring to the outer diameters of the intake valve head and exhaust valve head.

Valve head outer diameter:

Intake

Standard

36.9 — 37.1 mm (1.4528 — 1.4606 in)

Exhaust

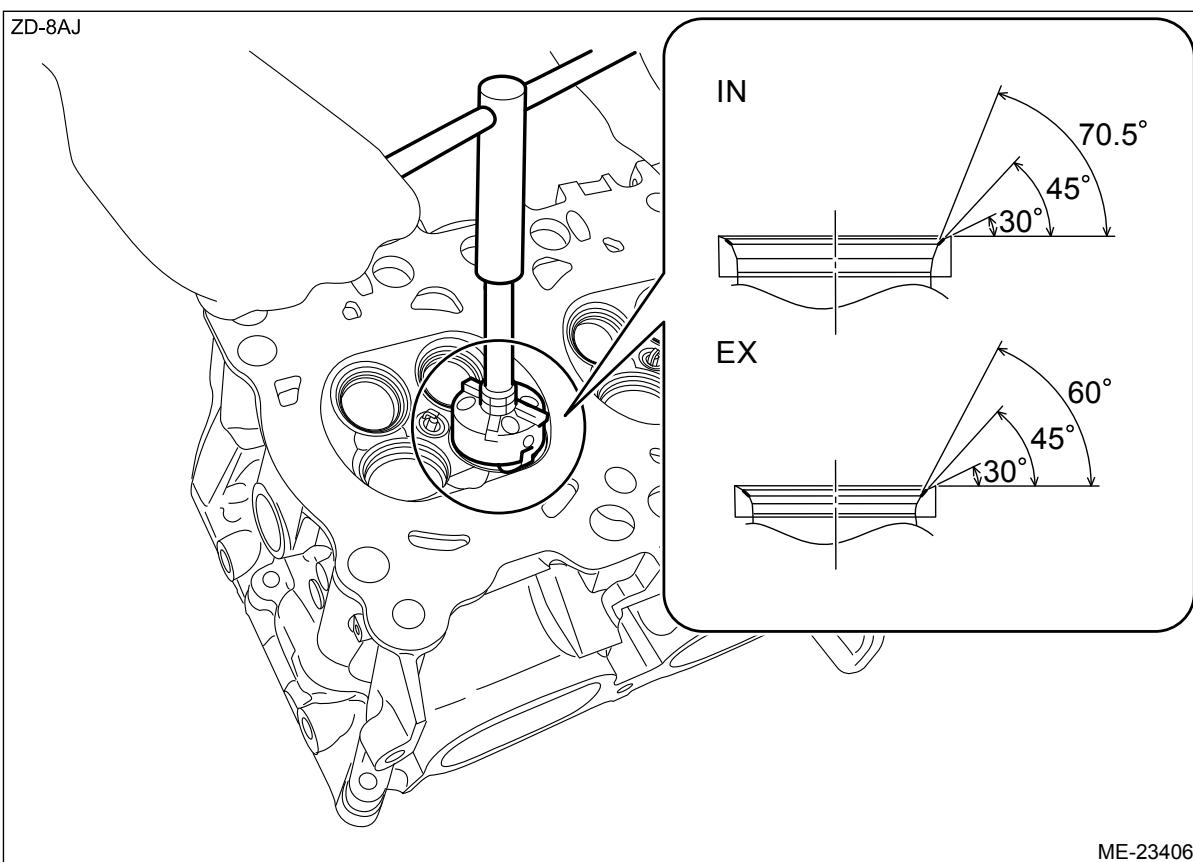
Standard

28.9 — 29.1 mm (1.1378 — 1.1457 in)

- Grind the seating surface so that the seating width between valve and valve seat becomes slightly larger than the standard value.
- Gradually reduce pressure at the end of grinding process in order to avoid creating a gap on the valve seat correcting surface.

Seating angle between valve and valve seat:

45°



(2) Lap the valve. For lapping procedure of the valve, refer to step 4.

(3) Check the seating position between valve and valve seat. For inspection of the seating position between valve and valve seat, refer to step 2.

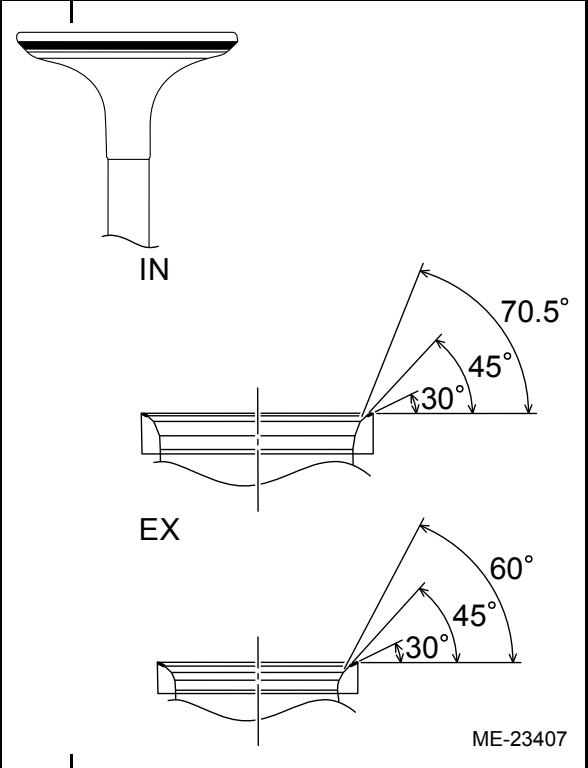
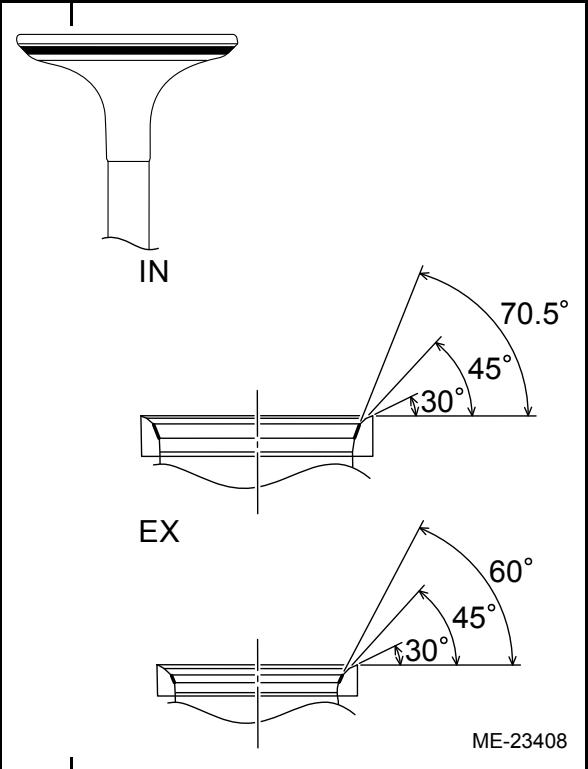
Note:

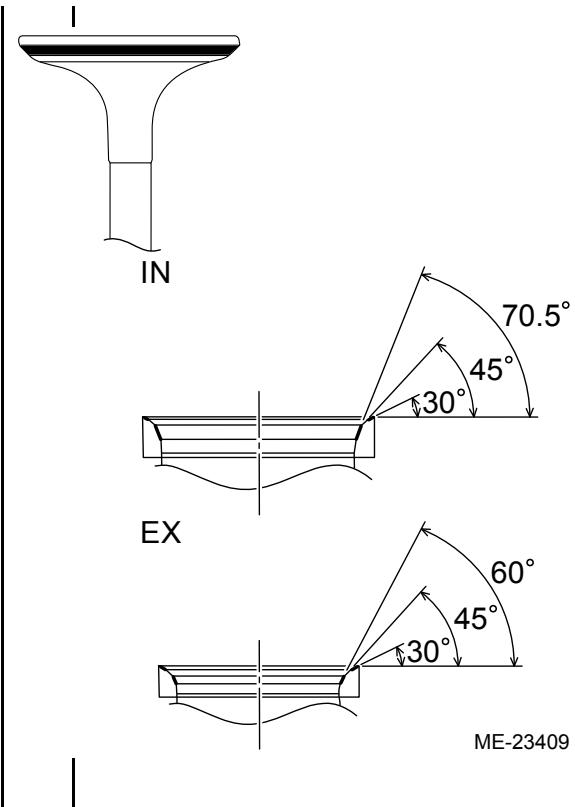
This procedure is necessary to select a seat cutter to be used in step (4).

(4) Using a seat cutter, correct the valve seat so that the seating width between valve and valve seat becomes the standard value.

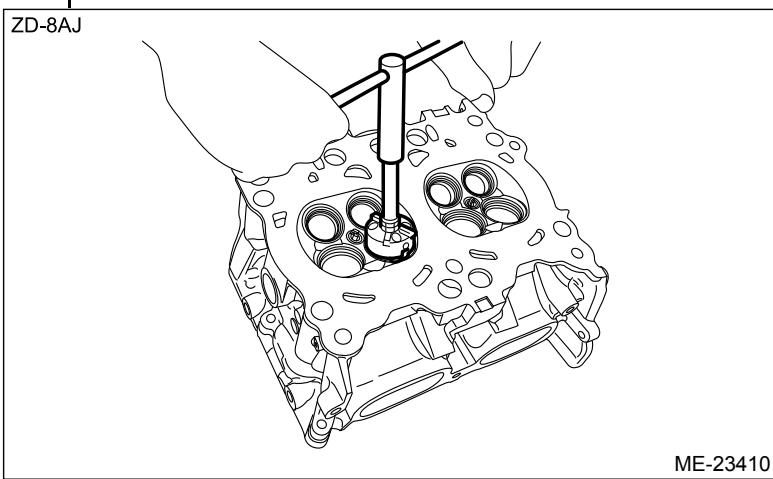
Note:

- Select a proper valve seat cutter according to the following table.

Seating position between valve and valve seat	Seat cutter selection
 <p>IN</p> <p>EX</p> <p>ME-23407</p>	<p>When the seating position of valve face is high, grind the surface using the 30° seat cutter until seating width between valve and valve seat becomes the standard value.</p>
 <p>IN</p> <p>EX</p>	<p>When the seating position of valve face is low, grind the surface using the 70.5° (IN) or 60° (EX) seat cutter until seating width between valve and valve seat reaches the standard value.</p>
	<p>When the seating position of valve face is at center, grind the surface evenly using the 30° and 70.5° (IN) or 60° (EX) seat cutters until seating width between valve and valve seat reaches the standard value.</p>



- Gradually reduce pressure at the end of grinding process in order to avoid creating a gap on the valve seat correcting surface.**



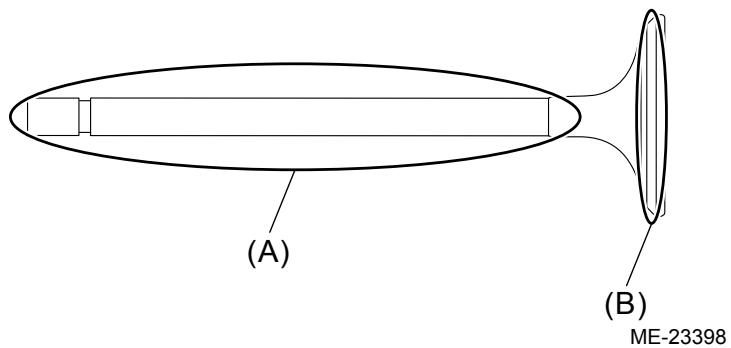
(5) Lap the valve. For lapping procedure of the valve, refer to step 4.

4. When lapping the valve

(1) Coat the stem (A) of the valve lightly with engine oil and put a small amount of valve compound evenly on the valve face (B).

Note:

- Be careful not to put the valve compound more than necessary.**
- To avoid damaging the valve guide and valve stem, be careful not to let the valve compound contact the valve stem.**



ME-23398

- (2) Using the valve lapper, slowly insert the valve with the valve compound applied into the valve guide, and lap the seating surface between valve and valve seat. First, lift the valve and strike it against the valve seat twice, and then slightly turn the valve once. Repeat these steps as one set.

Note:

- To prevent the seating width between valve and valve seat from exceeding the standard value, be careful not to keep turning the valve while pressing it against the valve seat during lapping.
- Be careful not to lift the valve too far during lapping in order to prevent the valve from coming off the valve guide.

- (3) Wipe off the valve compound on the valve and valve seat completely after lapping.

Note:

Be careful not to leave any valve compound in order to avoid malfunction.

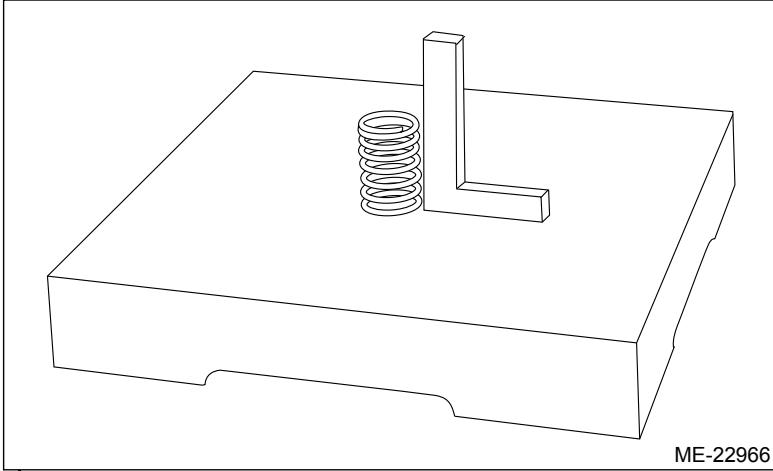
- (4) Check the seating width and seating position between valve and valve seat.

5. VALVE SPRING

1. Check the valve spring for damage and deformation.
2. Using a caliper gauge, valve spring tester, thickness gauge, surface plate and try square, check the valve spring free length (reference), tension/spring height and squareness. If it is not within the standard, replace the valve spring.

Note:

- Measurement should be performed at a temperature of 20°C (68°F).
- Valve spring free length is described as a reference. If only valve spring free length is out of the standard, it is not necessary to replace the valve spring.
- To check the squareness of the valve spring, stand the valve spring on a surface plate and check its deflection at the top of the valve spring using a try square.

**Valve spring free length (reference):****Intake**

44.55 mm (1.7539 in)

Exhaust

42.03 mm (1.6547 in)

Valve spring tension/spring height:**Set****Intake****Standard**

182 – 210 N (18.56 – 21.41 kgf, 40.92 – 47.21 lbf)/36.2 mm (1.4252 in)

Exhaust**Standard**

182 – 210 N (18.56 – 21.41 kgf, 40.92 – 47.21 lbf)/34.2 mm (1.3465 in)

Lift**Intake****Standard**

514 – 568 N (52.41 – 57.92 kgf, 115.57 – 127.71 lbf)/25.21 mm (0.9925 in)

Exhaust**Standard**

504 – 558 N (51.39 – 56.90 kgf, 113.32 – 125.46 lbf)/24.30 mm (0.9567 in)

Valve spring squareness:**Intake**

2.5°, 1.9 mm (0.0748 in) or less

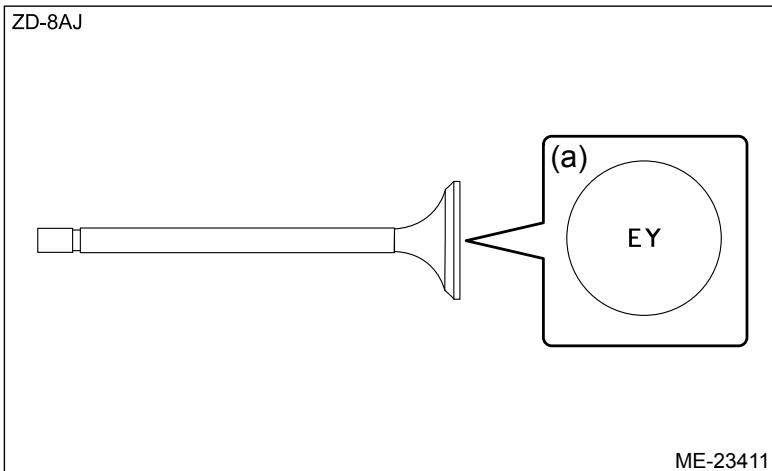
Exhaust

2.5°, 1.8 mm (0.0709 in) or less

DISPOSAL

Warning:

- Metallic sodium is encapsulated in the exhaust valve. Metallic sodium is a strong alkaline material and poses a risk of causing a severe chemical reaction. Use great care when handling and disposing it.
- If the metallic sodium gets into your eyes, you may lose your sight. If it touches the skin, you may get burned severely or if it touches flame, fire may be caused by chemical reaction. Therefore, do not disassemble the exhaust valve.
- It is safe when the metallic sodium encapsulated in the exhaust valve is not exposed to the air.
- When the exhaust valve is broken, remove the broken exhaust valve, and dispose of the metallic sodium.
- Do not intentionally break the exhaust valve and take out the metallic sodium.
- Identify the exhaust valve in which the metallic sodium is encapsulated with the embossed mark.



(a) Embossed mark
(identification: EY)

Caution:

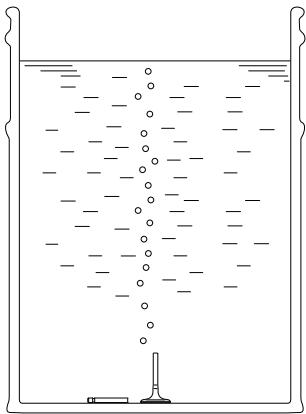
- When disposing of the exhaust valve that is not broken, entrust the disposal processing to the industrial waste disposer in charge of dissolution treatment.
- When the exhaust valve is broken, remove it from the cylinder head, perform appropriate processing in the same manner as the general steel material.
- When performing processing, be careful of the following.
 1. Prepare the fire extinguisher nearby.
 2. Wear the protective goggles.
 3. Wear rubber gloves.

1. Wear rubber gloves and remove the broken exhaust valve from the cylinder head.
2. Prepare large container (bucket or oil can) in well-ventilated place, and fill the container with water (10 L or more).
3. Using a pair of large tweezers or pliers, immerse the broken exhaust valve in the water vertically.

Caution:

- Completely immerse the broken exhaust valve in the water.
- Hydrogen gas is produced by the chemical reaction. Therefore, always keep the container away from open flames such as sparks.
- Because the severe chemical reaction is developed, keep at least 2 to 3 m away from the container.

SK-5CJ



ME-22969

4. After completion of chemical reaction (after the elapse of 4 — 5 hours), carefully take out the exhaust valve using a pair of large tweezers or pliers, and dispose of the exhaust valve according to the same disposal procedure the general steel material.

Caution:

- Concerning the liquid waste disposal of the liquid (sodium hydrate) produced in a chemical reaction, follow all governmental regulations and local regulations related to the liquid waste disposal.
- If the liquid produced in a chemical reaction (sodium hydrate) should touch the skin, immediately wash it away with plenty water.

MECHANICAL(H4DO) > Cylinder Block

REMOVAL



1. Remove the engine unit from the vehicle. [Ref. to MECHANICAL\(H4DO\)>Engine Assembly>REMOVAL.](#)
2. Remove the cylinder head. [Ref. to MECHANICAL\(H4DO\)>Cylinder Head>REMOVAL.](#)
3. Remove the crank sprocket. [Ref. to MECHANICAL\(H4DO\)>Crank Sprocket>REMOVAL.](#)
4. Remove the preheater pipe. [Ref. to COOLING\(H4DO\)>Water Pipe>REMOVAL > PREHEATER PIPE.](#)
5. Remove the water tank pipe assembly. [Ref. to COOLING\(H4DO\)>Water Pipe>REMOVAL > WATER TANK PIPE ASSEMBLY.](#)
6. Remove the PCV connector. [Ref. to EMISSION CONTROL \(AUX. EMISSION CONTROL DEVICES\) \(H4DO\)>PCV Connector>REMOVAL.](#)
7. Remove the knock sensor. [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>Knock Sensor>REMOVAL.](#)
8. Remove the PCV valve. [Ref. to EMISSION CONTROL \(AUX. EMISSION CONTROL DEVICES\) \(H4DO\)>PCV Valve>REMOVAL.](#)
9. Using the ST1, install the ST2 to the engine unit.

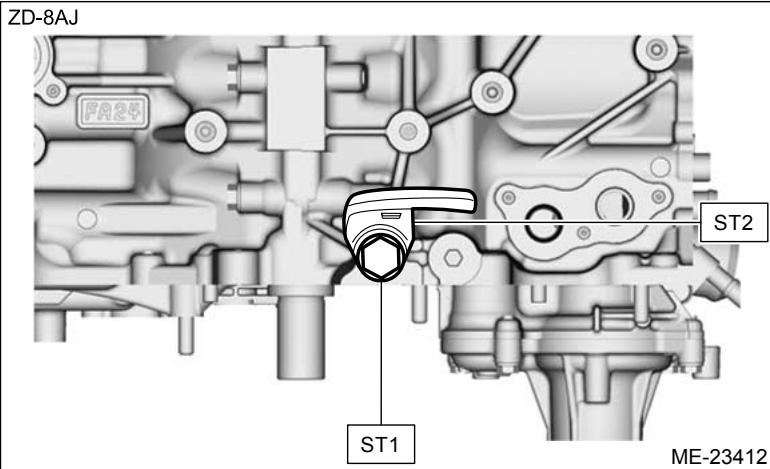
Preparation tool:

ST1: BOLT (90119-14120)

ST2: ENGINE HANGER NO.1 (12281-38150)

Tightening torque:

43 N·m (4.4 kgf-m, 31.7 ft-lb)



10. Using the engine mounting securing bolts or M10 × 23 × 1.25 bolts in the strength range of 8.8 (8.8 or 8 stamped on bolt head) or more, install the ST1, ST2 and ST3 to the oil pan upper.

Caution:

Be sure to use the engine mounting securing bolts or M10 × 23 × 1.25 bolts in the strength range of 8.8 (8.8 or 8 stamped on bolt head) or more in order to avoid damage to the cylinder block.

Preparation tool:

ST1: ENGINE STAND ADAPTER RH (498457000)

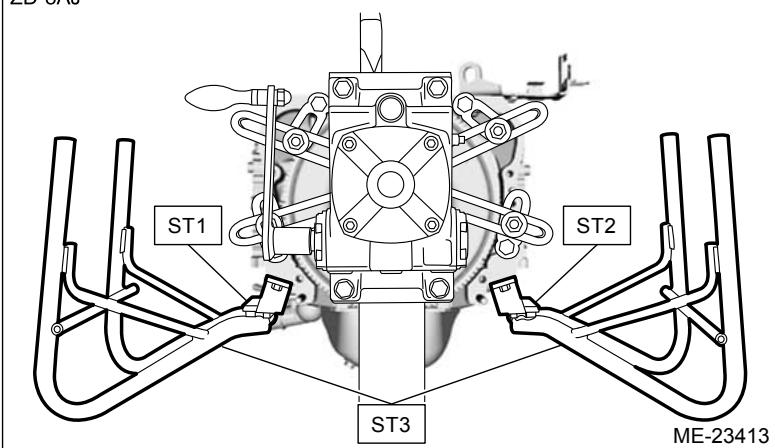
ST2: ENGINE STAND ADAPTER LH (498457100)

ST3: ENGINE STAND (499817100)

Tightening torque:

35 N·m (3.6 kgf-m, 25.8 ft-lb)

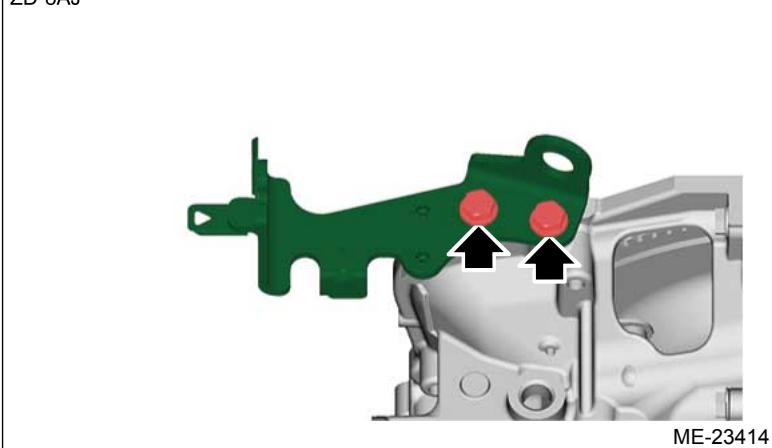
ZD-8AJ



11. Remove the cylinder block from the general-purpose engine stand with a lifting device and wire ropes.

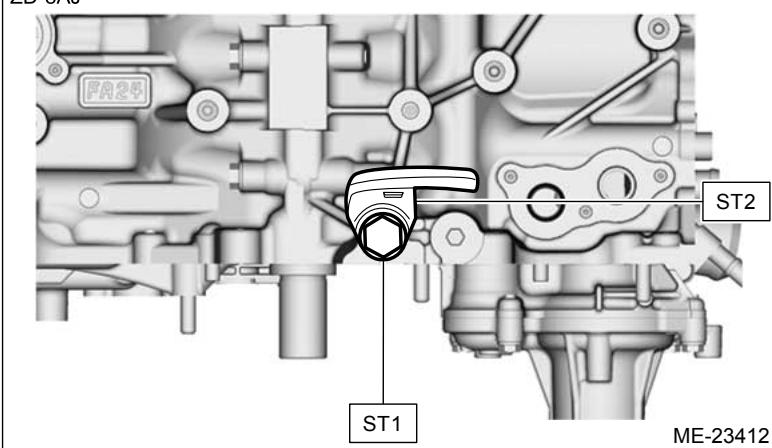
12. Remove the lifting device and wire ropes and the engine rear hanger from the cylinder block RH.

ZD-8AJ



13. Remove the ST1 and ST2 from the engine unit.

ZD-8AJ



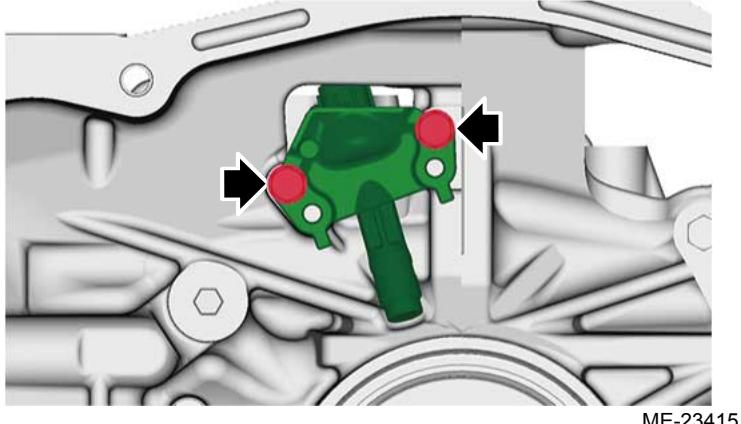
14. Remove the crankshaft position sensor plate with drive plate. (AT model) [Ref. to AUTOMATIC TRANSMISSION>Drive Plate>REMOVAL.](#)

15. Remove the crankshaft position sensor plate with flywheel. (MT model) [Ref. to CLUTCH](#)

[SYSTEM>Flywheel>REMOVAL.](#)

- 16.** Remove the bolts securing the crankshaft position sensor holder from the cylinder block LH, and remove the crankshaft position sensor with crankshaft position sensor holder.

ZD-8AJ



- 17.** Remove the piston pin from the piston and connecting rod.

Note:

Be careful not to confuse the piston pins.

- (1) Set the part so that the chain cover side is on the upper side.
- (2) Using the ST, turn it until the pistons of #1 cylinder and #2 cylinder are at the position (near the bottom dead position) as shown in the figure.

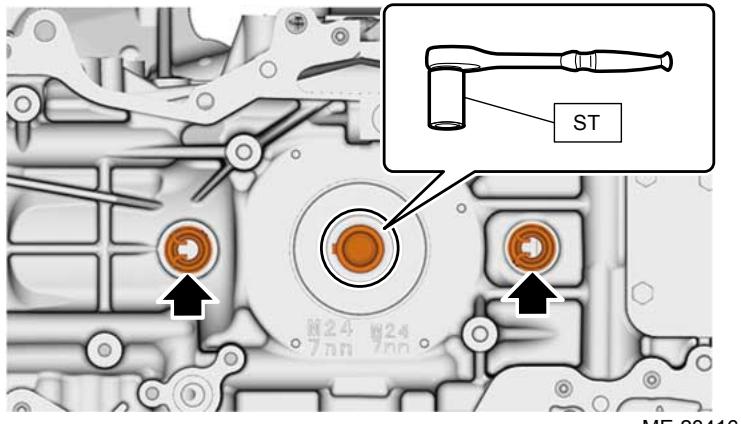
Note:

Align the position while checking the position from the service hole.

Preparation tool:

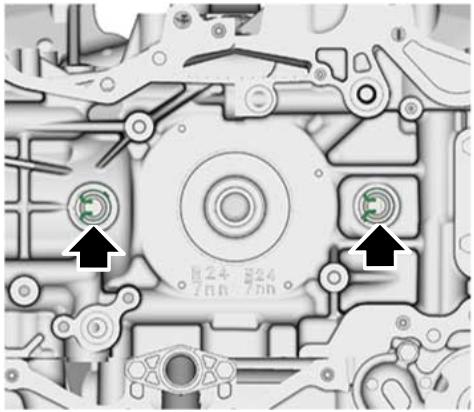
ST: CRANKSHAFT SOCKET (18252AA000)

ZD-8AJ



- (3) Remove the circlips from the service holes of #1 cylinder and #2 cylinder using long-nose pliers, etc.

ZD-8AJ

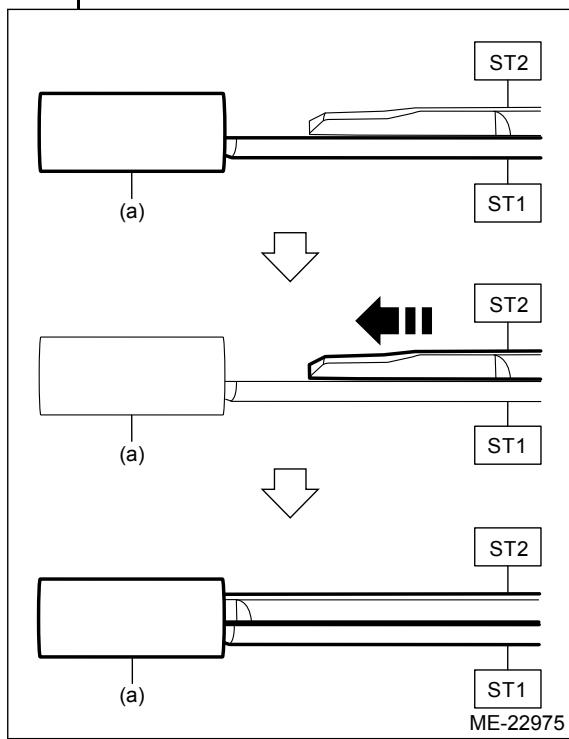


ME-23417

(4) Using the ST1 and ST2, pull out the piston pin from the piston and connecting rod.

Note:

- Use the ST1 with its tip replaced with ST2.
- Set the ST1 on the piston pin and slide the ST2 toward the piston pin to lock.



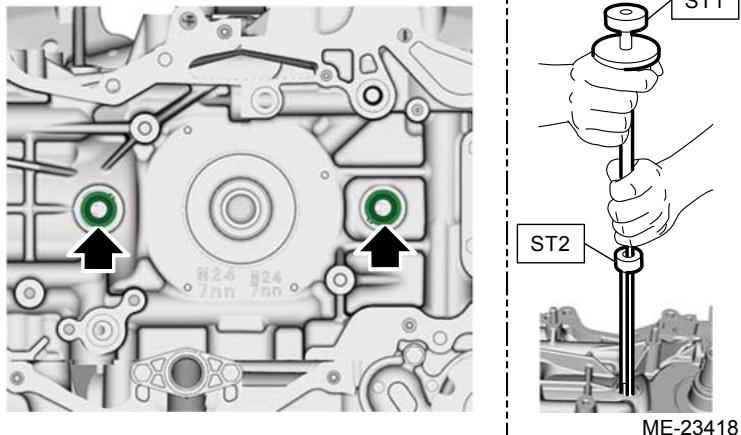
(a) Piston pin

Preparation tool:

ST1: PISTON PIN REMOVER ASSY (499097600)

ST2: PISTON PIN REMOVER (18333AA000)

ZD-8AJ



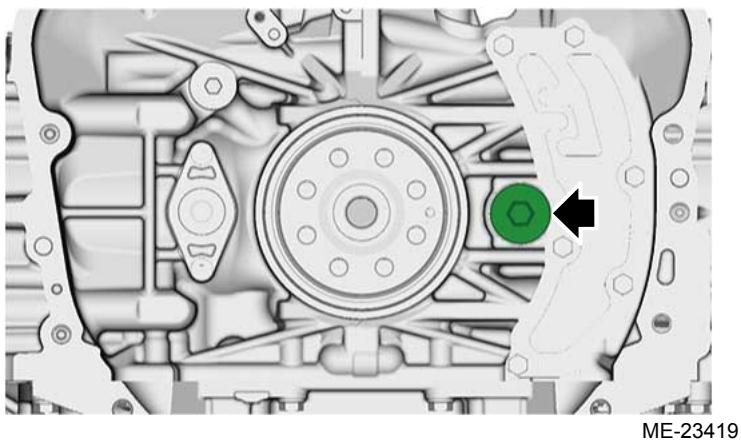
(5) Set the part so that the rear oil seal side is on the upper side.

(6) Remove the service hole plug from the cylinder block RH.

Note:

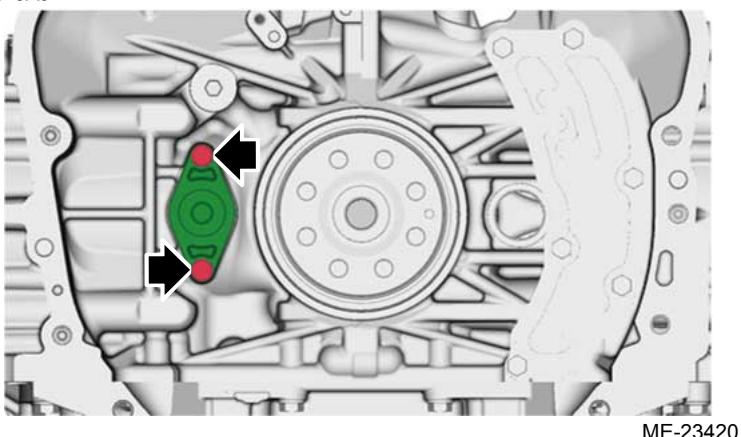
After removing it, remove the seal material from the thread hole of the service hole plug.

ZD-8AJ



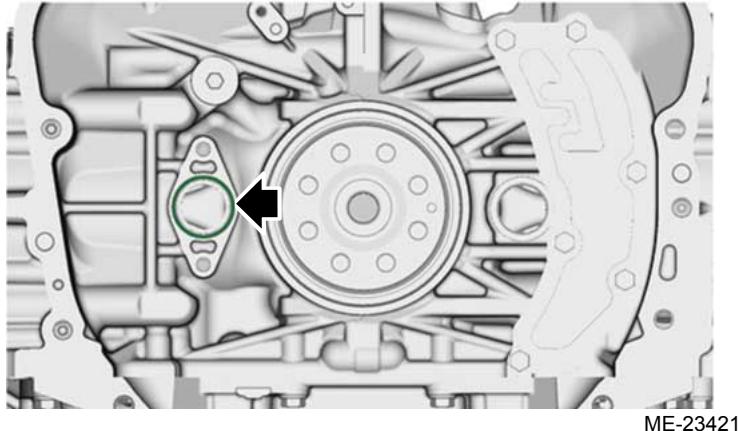
(7) Remove the service hole cover from the cylinder block LH.

ZD-8AJ



(8) Remove the O-ring from the cylinder block LH.

ZD-8AJ



(9) Following the same procedures as used for #1 cylinder and #2 cylinder, pull out the piston pins.

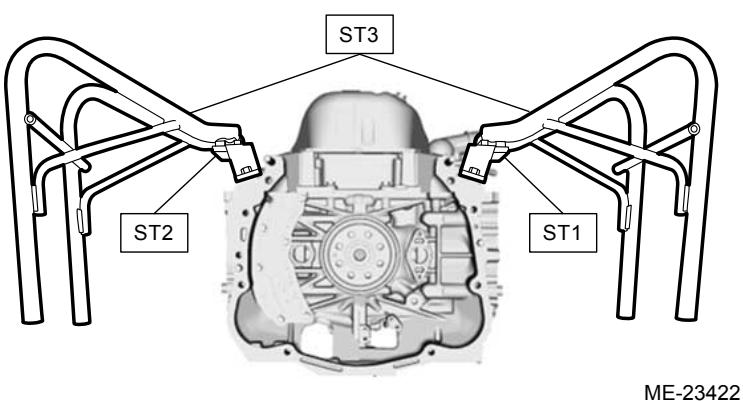
Caution:

This step allows the connecting rods of all cylinders to move freely. During operations after this step, be careful not to damage the cylinder block by the connecting rod.

18. Set the part so that the oil pan upper is on the upper side.

19. Remove the ST1, ST2 and ST3 from the oil pan upper.

ZD-8AJ



20. Remove the oil pan upper. [Ref. to LUBRICATION\(H4DO\)>Oil Pan>REMOVAL > OIL PAN UPPER.](#)

21. Separate the cylinder block.

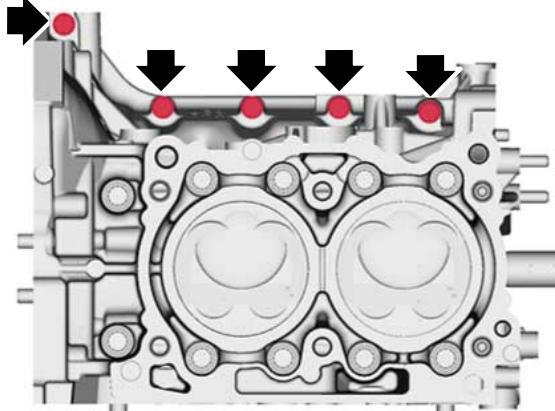
(1) Set the part so that the cylinder block RH is on the upper side.

Caution:

- Place a wood board wrapped with a waste cloth to prevent the knock pin damage and to stabilize the cylinder block.
- Be careful not to scratch the mating surface with the cylinder head LH during work.

(2) Remove the bolt shown in the figure.

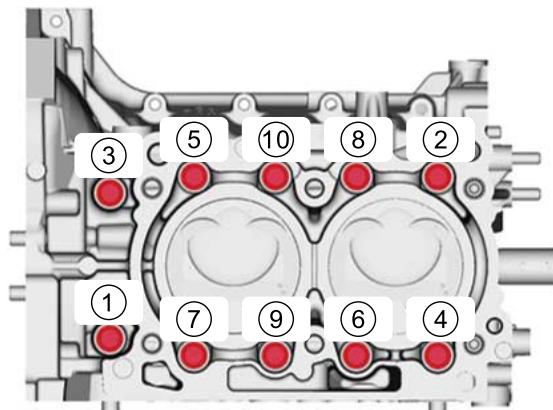
ZD-8AJ



ME-23423

- (3) Loosen the cylinder block mounting bolts in numerical order as shown in the figure, and then remove the bolts.

ZD-8AJ



ME-23424

- (4) While tapping the cylinder block RH with a plastic hammer, separate the cylinder block RH from the cylinder block LH.

Caution:

When separating the cylinder block, be careful not to damage the cylinder block by the connecting rod.

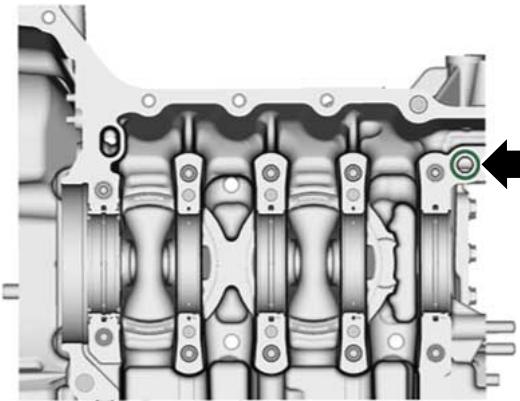
Note:

Lift the cylinder block RH gradually, and confirm that the crankshaft is remaining in the cylinder block LH. Lifting the cylinder block RH carelessly may cause the crankshaft to fall off.

22. Remove the crankshaft together with the connecting rod from the cylinder block LH, and remove the rear oil seal.

23. Remove the O-ring from the cylinder block LH.

ZD-8AJ



ME-23425

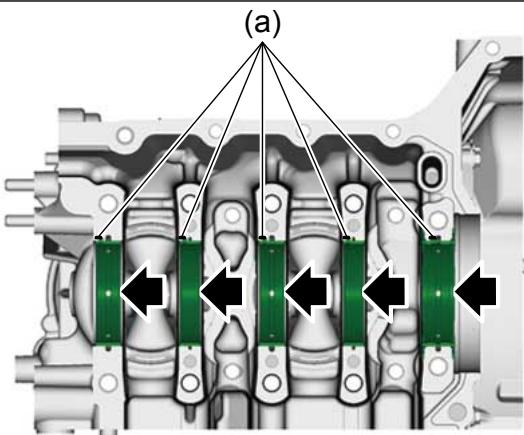
24. Remove the crankshaft bearings from the cylinder block.

Note:

- Be careful not to confuse the crankshaft bearing combination.
- Press the bearing at the end opposite to locking lip (a).

- RH side

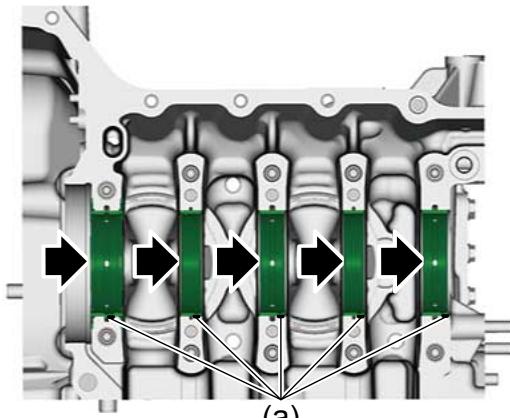
ZD-8AJ



ME-23426

- LH side

ZD-8AJ



ME-23427

25. Remove each piston from the cylinder block using a hammer handle, etc.

Note:

- Be careful not to confuse the original combination of piston and cylinder.

26. Remove the liquid gasket from cylinder block.

MECHANICAL(H4DO) > Cylinder Block

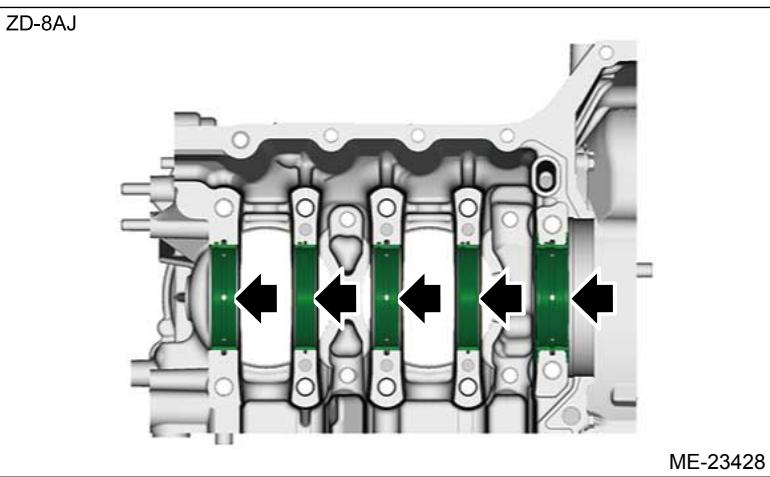
INSTALLATION

1. Apply engine oil to the crankshaft bearing, and install the crankshaft bearing to the cylinder block.

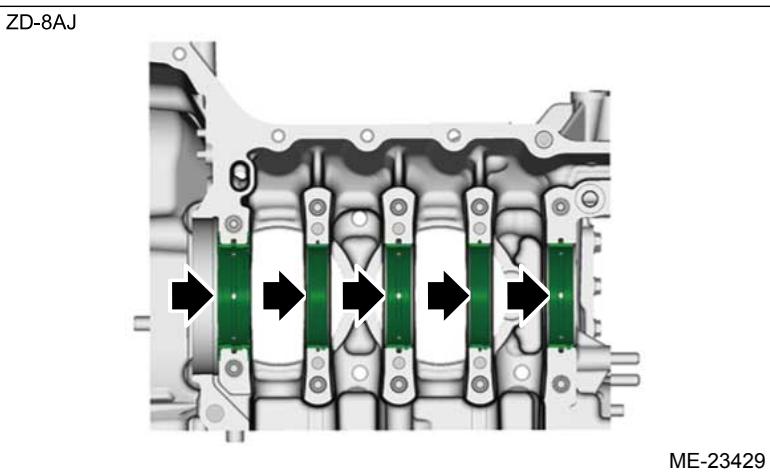
Caution:

- Place a wood board wrapped with a waste cloth to prevent the knock pin damage and to stabilize the cylinder block before work.
- Be careful not to scratch the mating surface with the cylinder head during work.

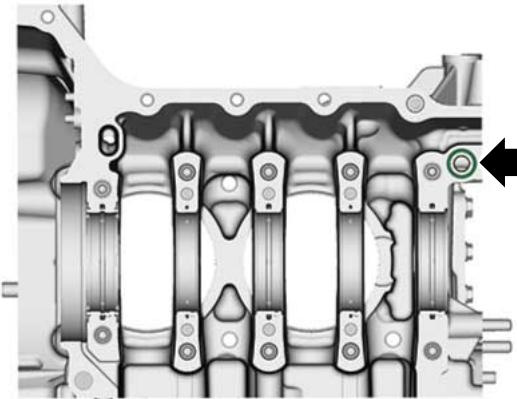
- RH side



- LH side



2. Install new O-rings to the cylinder block LH.



ME-23430

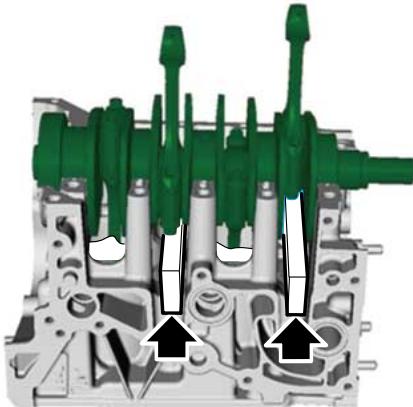
- 3.** Apply engine oil to the crankshaft journal, and set the crankshaft together with the connecting rod to cylinder block LH.

Caution:

Before setting the crankshaft together with the connecting rod, wrap the connecting rod small end on the cylinder block LH side with cloth, etc. to protect the cylinder.

Note:

Using a wood board, etc., adjust the connecting rod on the cylinder block RH side to a position where it can be inserted into the cylinder block RH, and hold it.



ME-23431

- 4.** Apply liquid gasket to the mating surface of cylinder block RH as shown in the figure.

Caution:

- Place a wood board wrapped with a waste cloth to prevent the knock pin damage and to stabilize the cylinder block before work.
- Be careful not to scratch the mating surface of cylinder block during work.
- Do not let the liquid gasket overflow to the oil passage and crankshaft bearing portions, because the engine seizure may result.

Note:

- Before applying liquid gasket, degrease the old liquid gasket seal surface of the cylinder block RH and cylinder block LH.
- Install within 5 min. after applying liquid gasket.

Preparation items:

Liquid gasket: THREE BOND 1217G (part No. K0877Y0100), THREE BOND 1217H or equivalent

Liquid gasket applying diameter:

Mating surfaces other than ranges A, B and C

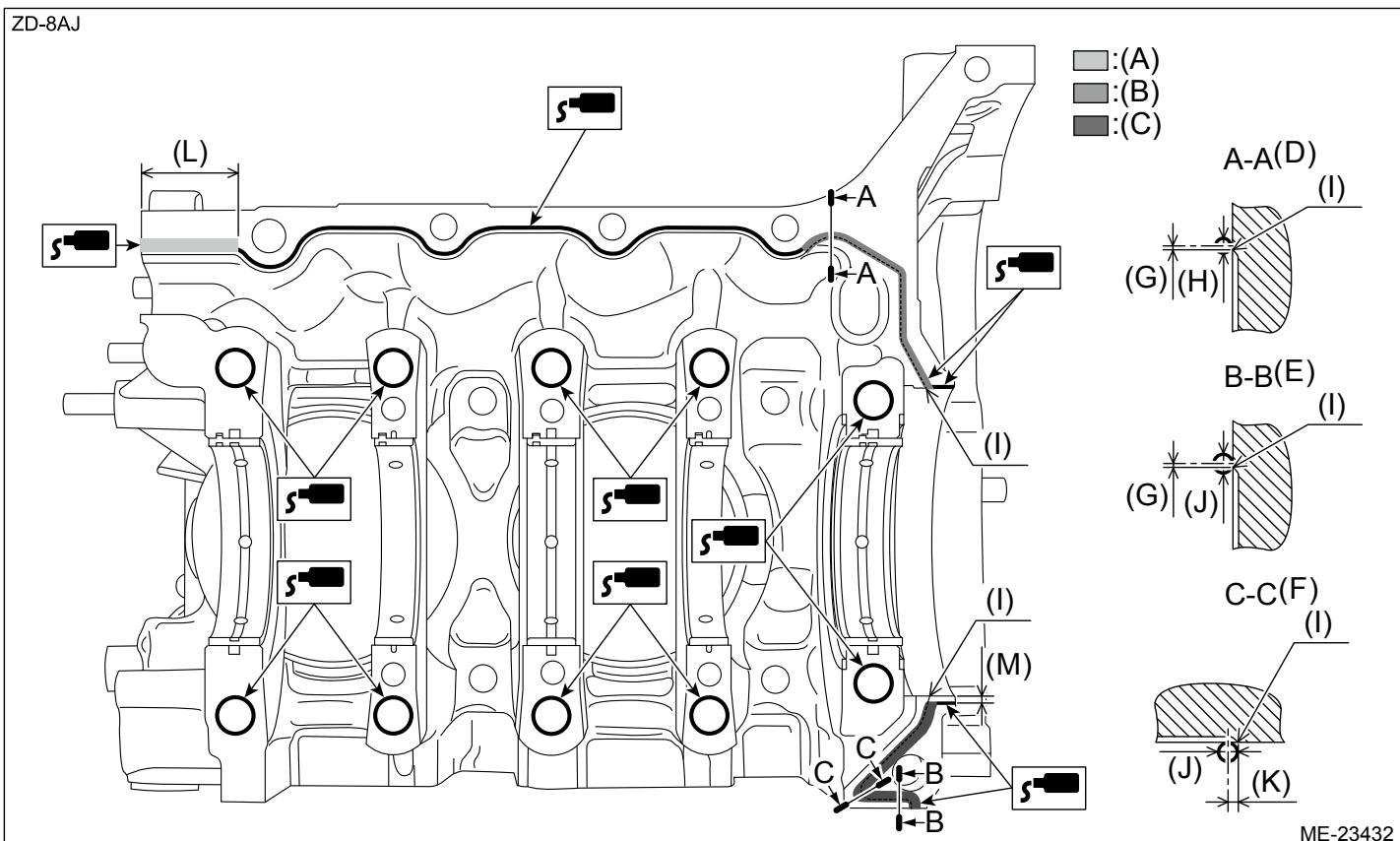
$1 \pm 0.5 \text{ mm} (0.0394 \pm 0.0197 \text{ in})$

Mating surfaces of ranges A and C

$4 \pm 0.5 \text{ mm} (0.1575 \pm 0.0197 \text{ in})$

Mating surfaces of range B

$3.2 \pm 0.5 \text{ mm} (0.1260 \pm 0.0197 \text{ in})$



(A) Range A

(F) Liquid gasket applying position of mating surfaces (the edge) of range C

(K) 2 mm (0.0787 in)

(B) Range B

(G) Within 1 mm (0.0394 in)

(L) 36 mm (1.4173 in)

(C) Range C

(H) $\phi 3.2 \pm 0.5 \text{ mm}$ ($0.1260 \pm 0.0197 \text{ in}$)

(M) 2.5 mm (0.0984 in)

(D) Liquid gasket applying position of mating surfaces of range B

(I) Chamfer edge

(E) Liquid gasket applying position of mating surfaces (other than the edge) of range C

(J) $\phi 4 \pm 0.5 \text{ mm}$ ($0.1575 \pm 0.0197 \text{ in}$)

5. Install the cylinder block RH to the cylinder block LH.

Caution:

When installing the cylinder block RH, be careful not to damage the cylinder block by the connecting rod.

Note:

During installation, be careful not to let the connecting rod on the cylinder block RH side come in contact with the cylinder inside.

6. Join the cylinder blocks.

Caution:

When tightening the mounting bolts, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.

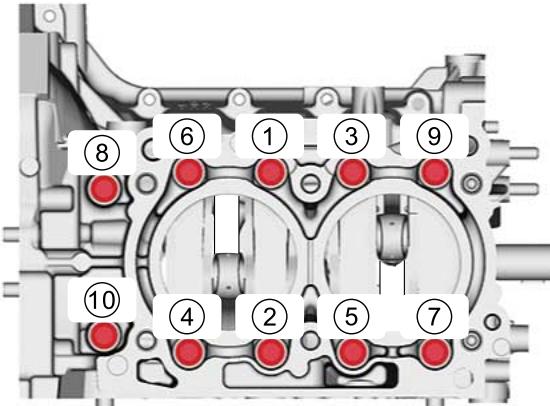
- (1) Apply a coat of engine oil to the washers and cylinder block mounting bolt threads.

Note:

To prevent mixture of engine oil into the water jacket, do not apply a large amount.

- (2) Tighten all mounting bolts with a torque of 35 N·m (3.6 kgf-m, 25.8 ft-lb) in numerical order as shown in the figure.
- (3) Loosen all mounting bolts by 180° in the reverse order of tightening in step (2).
- (4) Tighten all mounting bolts with a torque of 35 N·m (3.6 kgf-m, 25.8 ft-lb) in numerical order as shown in the figure.
- (5) Loosen the mounting bolts (4 places) by 180° in the order of 6 → 5 → 4 → 3 as shown in the figure.
- (6) Tighten the mounting bolts (4 places) with a torque of 17 N·m (1.7 kgf-m, 12.5 ft-lb) in the order of 3 → 4 → 5 → 6 as shown in the figure.
- (7) Using an angle gauge, tighten the mounting bolts (4 places) by 58 – 62 ° in the order of 3 → 4 → 5 → 6 as shown in the figure.
- (8) Loosen the mounting bolts (6 places) by 180° in the order of 8 → 7 → 10 → 9 → 2 → 1 as shown in the figure.
- (9) Tighten the mounting bolts (6 places) with a torque of 17 N·m (1.7 kgf-m, 12.5 ft-lb) in the order of 1 → 2 → 9 → 10 → 7 → 8 as shown in the figure.
- (10) Using an angle gauge, tighten the mounting bolts (3 places) by 58 – 62 ° in the order of 1 → 2 → 9 as shown in the figure.
- (11) Using an angle gauge, tighten the mounting bolt 10 (1 place) shown in the figure by 78 – 82 °.
- (12) Using an angle gauge, tighten the mounting bolt 7 (1 place) shown in the figure by 58 – 62 °.
- (13) Using an angle gauge, tighten the mounting bolt 8 (1 place) shown in the figure by 78 – 82 °.

ZD-8AJ



ME-23433

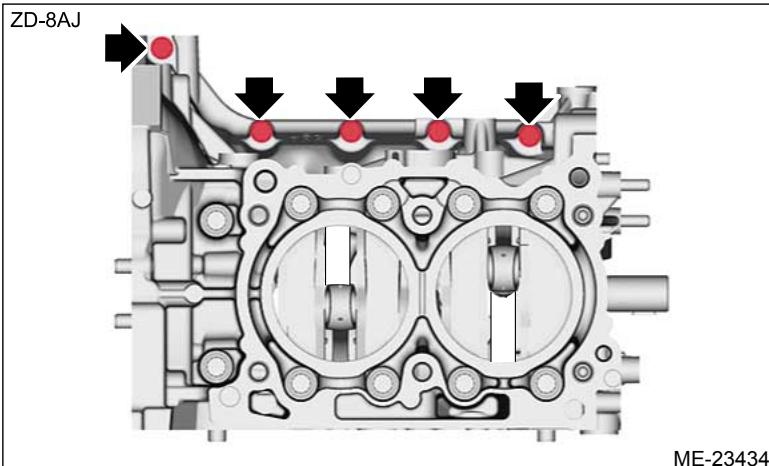
- (14) Install the bolt shown in the figure.

Note:

After tightening, if the liquid gasket is squeezed out onto the seal surfaces of the chain cover and oil pan upper, remove any squeezed-out liquid gasket. Any liquid gasket on the chamfer area, however, should not be removed.

Tightening torque:

25 N·m (2.5 kgf-m, 18.4 ft-lb)



(15) Remove the wood board, etc. securing the connecting rod on the cylinder block RH side.

Caution:

Before removing the wood board, etc., wrap the connecting rod small end on the cylinder block RH side with cloth, etc. to protect the cylinder.

7. Set the part so that the oil pan upper side is on the upper side.

Caution:

As the connecting rod can move freely, use special care not to damage the cylinder block by the connecting rod after this procedure until the piston pin is installed.

8. Install the oil pan upper. [Ref. to LUBRICATION\(H4DO\)>Oil Pan>INSTALLATION > OIL PAN UPPER.](#)

9. Using the engine mounting securing bolts or M10 × 23 × 1.25 bolts in the strength range of 8.8 (8.8 or 8 stamped on bolt head) or more, install the ST1, ST2 and ST3 to the oil pan upper.

Caution:

Be sure to use the engine mounting securing bolts or M10 × 23 × 1.25 bolts in the strength range of 8.8 (8.8 or 8 stamped on bolt head) or more in order to avoid damage to the cylinder block.

Preparation tool:

ST1: ENGINE STAND ADAPTER RH (498457000)

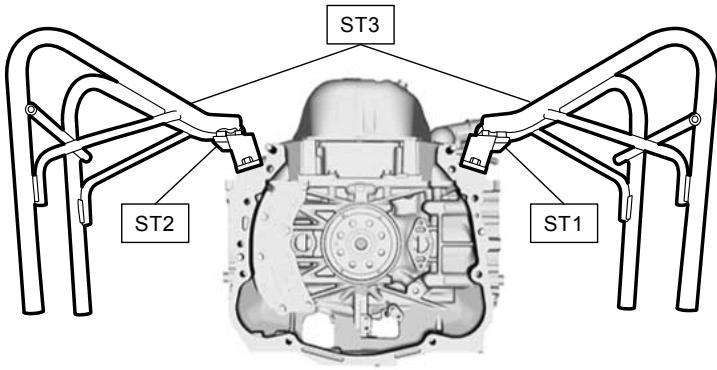
ST2: ENGINE STAND ADAPTER LH (498457100)

ST3: ENGINE STAND (499817100)

Tightening torque:

35 N·m (3.6 kgf-m, 25.8 ft-lb)

ZD-8AJ



ME-23435

10. Set the piston and install the piston pin to the piston and connecting rod.

- (1) Set the part so that the chain cover side is on the upper side.
- (2) Remove the protective cloth, etc. wrapped around the connecting rod small end of the #1 cylinder and #2 cylinder.
- (3) Using the ST, turn it until the connecting rod small ends of #1 cylinder and #2 cylinder are aligned with the service hole (near the bottom dead position).

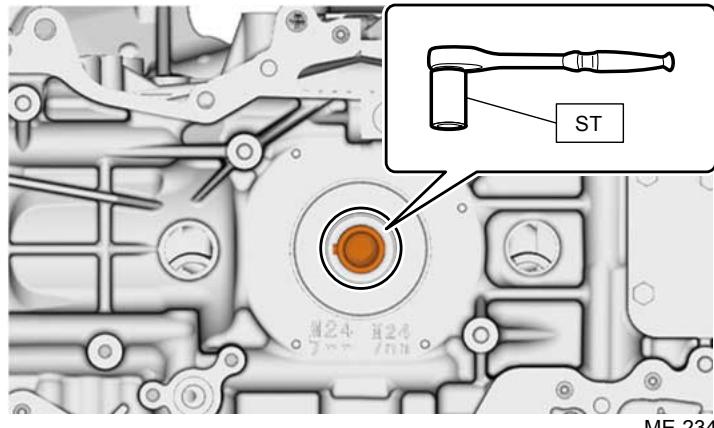
Note:

While turning, check the connecting rod position from the cylinder and service hole.

Preparation tool:

ST: CRANKSHAFT SOCKET (18252AA000)

ZD-8AJ



ME-23436

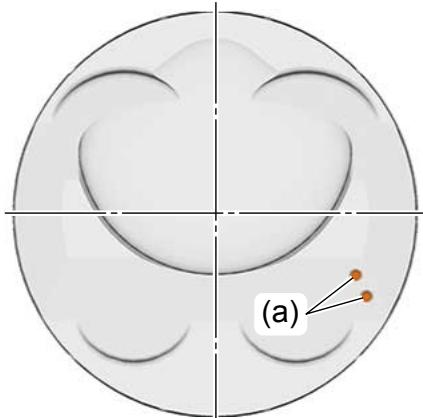
- (4) Check that the circlip installation position and the piston ring gap for each piston are positioned correctly. [Ref. to MECHANICAL\(H4DO\)>Cylinder Block>ASSEMBLY > PISTON.](#)

- (5) Compress the piston ring using piston ring compressor, and insert the pistons of #1 cylinder and #2 cylinder into cylinder block.

Note:

- Apply engine oil to the outer circumference of the piston and in the cylinder block.
- Before inserting the piston, move the connecting rod to around the center of the cylinder.
- Face the piston front mark (round mark) towards the front of the engine.
- RH side

ZD-8AJ

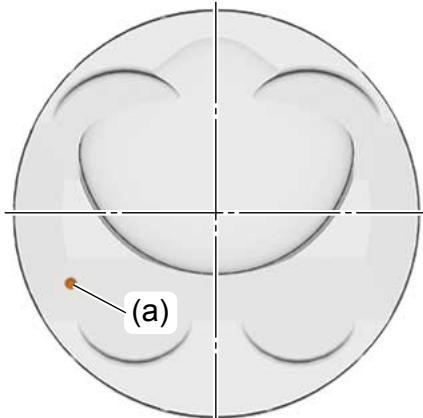


ME-23437

(a) Front mark

- LH side

ZD-8AJ



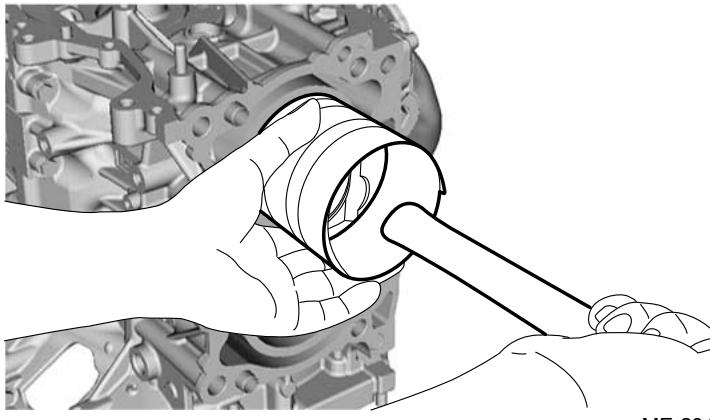
ME-23438

(a) Front mark

- Insert until the piston pin hole and the connecting rod small end are almost at the same position while lightly tapping the crown of the piston with the handle of a plastic hammer and while checking the position of the piston pin hole and the connecting rod small end from the service hole.

- RH side

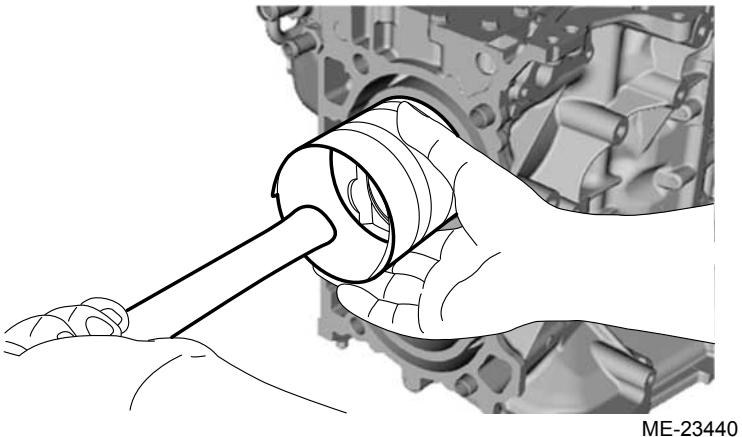
ZD-8AJ



ME-23439

- LH side

ZD-8AJ



ME-23440

(6) Using the ST, align the position of the piston pin hole and the connecting rod small end.

Caution:

To prevent the circlip installed to the piston from falling off, use special care not to apply excessive force to the circlip while aligning the position using the ST.

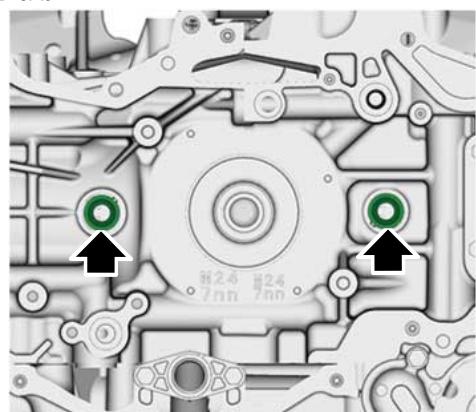
Note:

Apply a thin coat of engine oil to the ST.

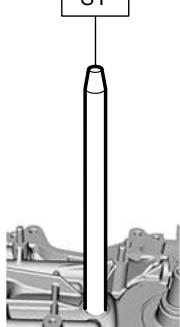
Preparation tool:

ST: PISTON PIN GUIDE (18253AA000)

ZD-8AJ



ST

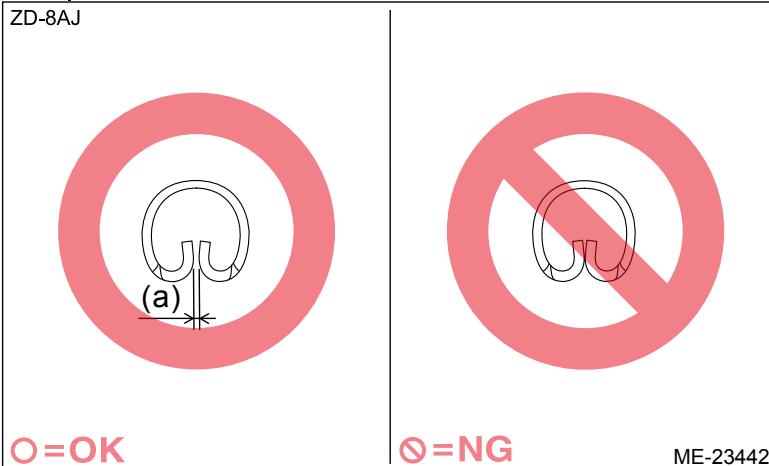


ME-23441

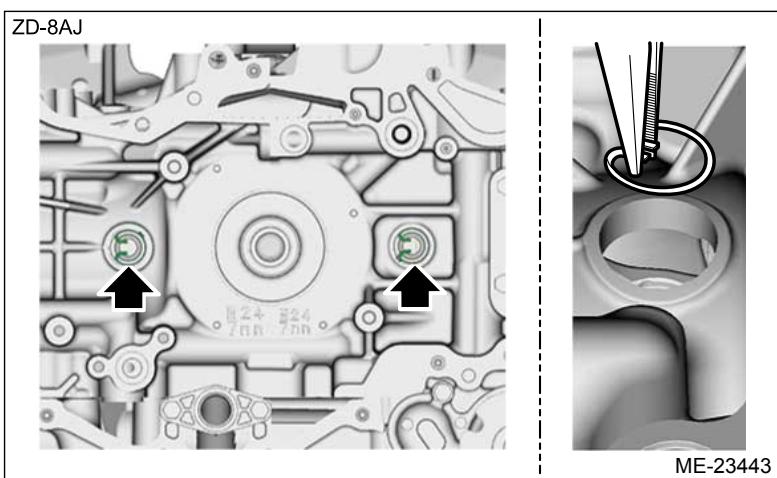
- (7) Apply a thin coat of engine oil to piston pins, and insert them into pistons and connecting rods of #1 cylinder and #2 cylinder.
- (8) Install new circlips to the piston.

Caution:

- When installing the circlip using long-nose pliers, do not allow the circlip claw sections to contact with each other as shown in the figure.



- (a) Gap between the circlip claw sections: 1 mm (0.0394 in) or more
- After operation, make sure the circlip is firmly installed on the circlip groove of the piston.
 - If the circlip needs to be reinstalled after installed to the piston, the circlip cannot be reused. Use a new circlip.



- (9) Set the part so that the rear oil seal side is on the upper side.

Caution:

- When moving the cylinder block, be careful not to damage the cylinder block by the connecting rod.

- (10) Following the same procedures as used for #1 cylinder and #2 cylinder, set the piston to the #3 cylinder and #4 cylinder and install the piston pins to the pistons and connecting rods.
- (11) Install the service hole plug to the cylinder block RH.

Caution:

Always use a new service hole plug.

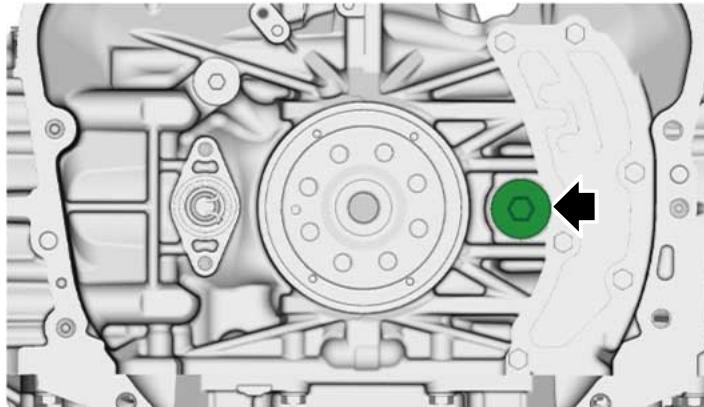
Note:

Before installing the service hole plug, degrease the thread portion for securing service hole plug of the cylinder block RH.

Tightening torque:

70 N·m (7.1 kgf-m, 51.6 ft-lb)

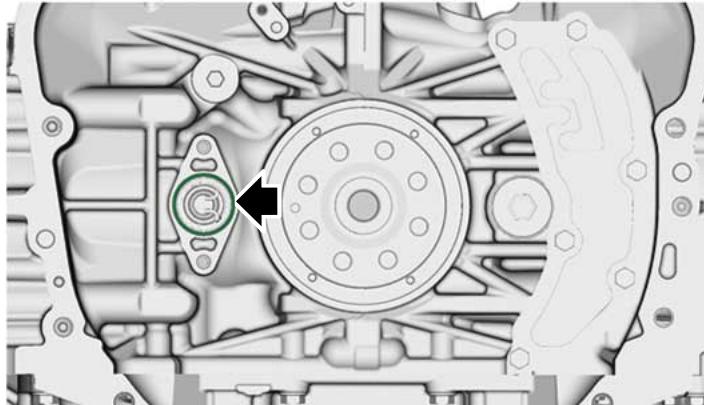
ZD-8AJ



ME-23444

(12) Install new O-rings to the cylinder block LH.

ZD-8AJ



ME-23445

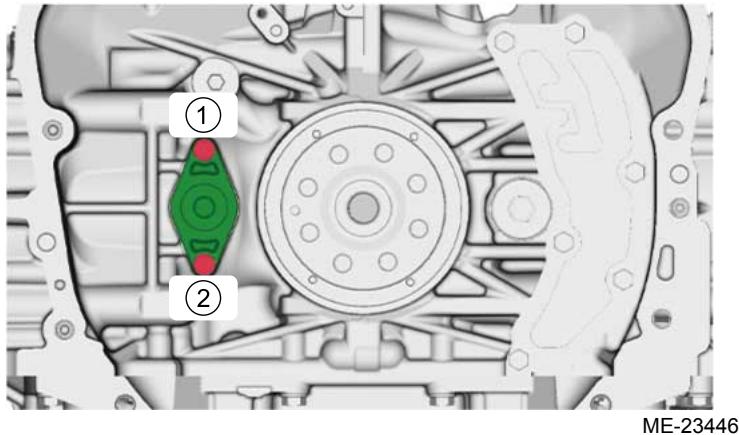
(13) Install the service hole cover to the cylinder block LH.

- 1) Tighten the bolts with a torque of 6.4 N·m (0.7 kgf-m, 4.7 ft-lb) in numerical order 1 → 2 as shown in the figure.
- 2) Tighten the bolt 1 shown in the figure with a torque of 6.4 N·m (0.7 kgf-m, 4.7 ft-lb) again.

Note:

This procedure is necessary to stabilize torque.

ZD-8AJ

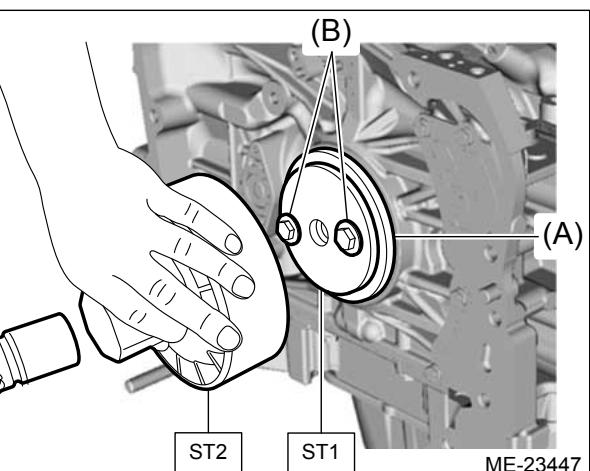


11. Set the part so that the installation surface of the intake manifold is on the upper side.
12. Apply a thin coat of engine oil to the oil seal inner periphery and outer periphery, and install new rear oil seal using ST1 and ST2.

Preparation tool:

ST1: OIL SEAL GUIDE (18671AA020)
ST2: OIL SEAL INSTALLER (18657AA030)

ZD-8AJ



(A) Rear oil seal

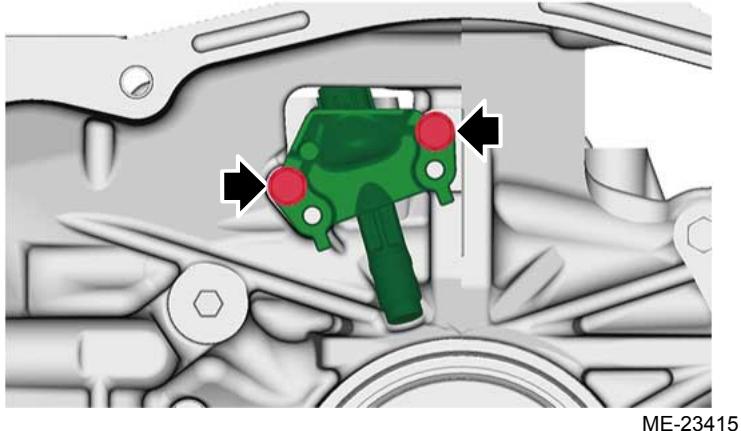
(B) Drive plate mounting bolt or
flywheel mounting bolt

13. Install the crankshaft position sensor with crankshaft position sensor holder to the cylinder block LH.

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

ZD-8AJ



14. Install the crankshaft position sensor plate with drive plate. (AT model) [Ref. to AUTOMATIC TRANSMISSION>Drive Plate>INSTALLATION.](#)

15. Install the crankshaft position sensor plate with flywheel. (MT model) [Ref. to CLUTCH SYSTEM>Flywheel>INSTALLATION.](#)

16. Using the ST1, install the ST2 to the engine unit.

Preparation tool:

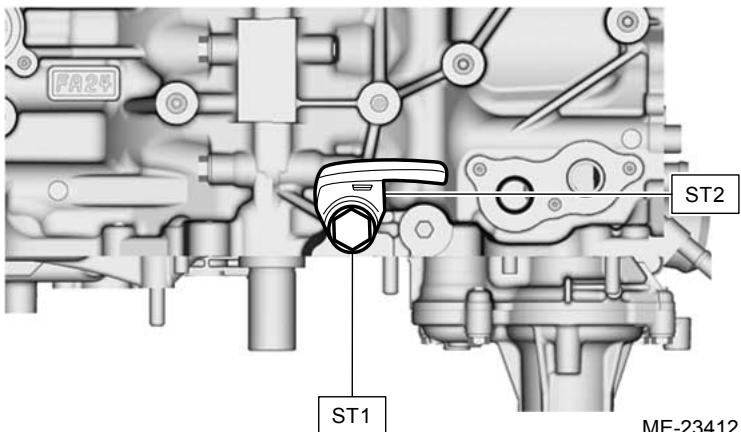
ST1: BOLT (90119-14120)

ST2: ENGINE HANGER NO.1 (12281-38150)

Tightening torque:

43 N·m (4.4 kgf-m, 31.7 ft-lb)

ZD-8AJ

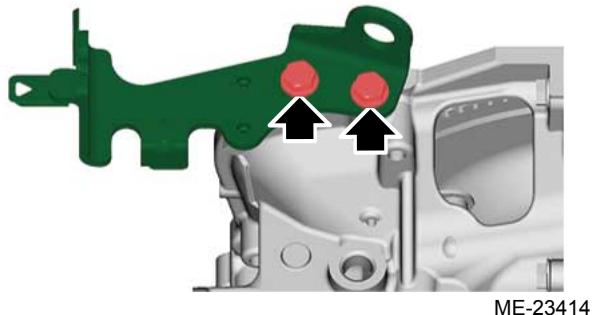


17. Install the engine rear hanger to the cylinder block RH.

Tightening torque:

21 N·m (2.1 kgf-m, 15.5 ft-lb)

ZD-8AJ

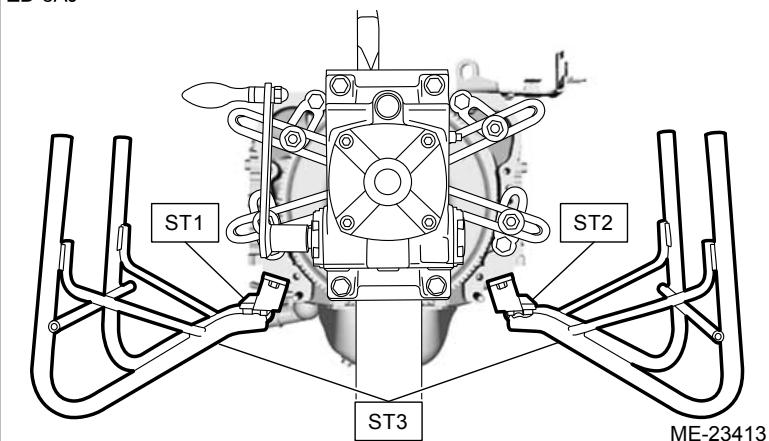


18. Install the cylinder block to the general-purpose engine stand with a lifting device and wire ropes.

[Ref. to MECHANICAL\(H4DO\)>Preparation for Overhaul>PROCEDURE.](#)

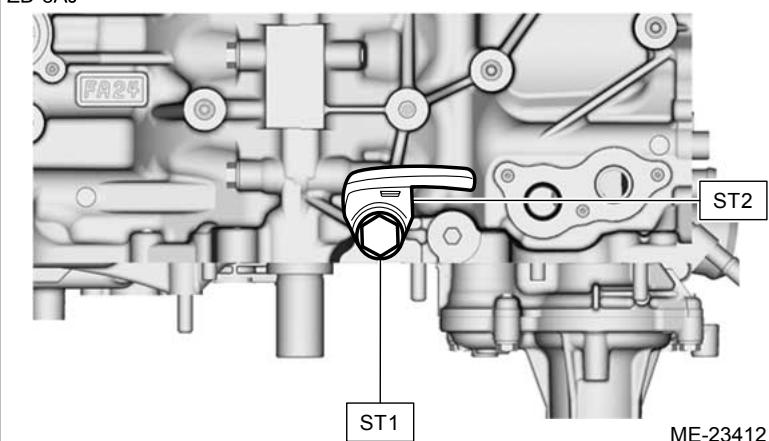
19. Remove the lifting device and wire ropes, and remove the ST1, ST2 and ST3 from the oil pan upper.

ZD-8AJ



20. Remove the ST1 and ST2 from the engine unit.

ZD-8AJ



21. Install the PCV valve. [Ref. to EMISSION CONTROL \(AUX. EMISSION CONTROL DEVICES\)\(H4DO\)>PCV Valve>INSTALLATION.](#)

22. Install the knock sensor. [Ref. to FUEL INJECTION \(FUEL SYSTEMS\)\(H4DO\)>Knock Sensor>INSTALLATION.](#)

23. Install the PCV connector. [Ref. to EMISSION CONTROL \(AUX. EMISSION CONTROL DEVICES\).](#)

[\(H4DO\)>PCV Connector>INSTALLATION.](#)

24. Install the water tank pipe assembly.  [Ref. to COOLING\(H4DO\)>Water Pipe>INSTALLATION > WATER TANK PIPE ASSEMBLY.](#)

25. Install the preheater pipe.  [Ref. to COOLING\(H4DO\)>Water Pipe>INSTALLATION > PREHEATER PIPE.](#)

26. Install the crank sprocket.  [Ref. to MECHANICAL\(H4DO\)>Crank Sprocket>INSTALLATION.](#)

27. Install the cylinder head.  [Ref. to MECHANICAL\(H4DO\)>Cylinder Head>INSTALLATION.](#)

28. Install the engine unit to the vehicle.  [Ref. to MECHANICAL\(H4DO\)>Engine Assembly>INSTALLATION.](#)

MECHANICAL(H4DO) > Cylinder Block

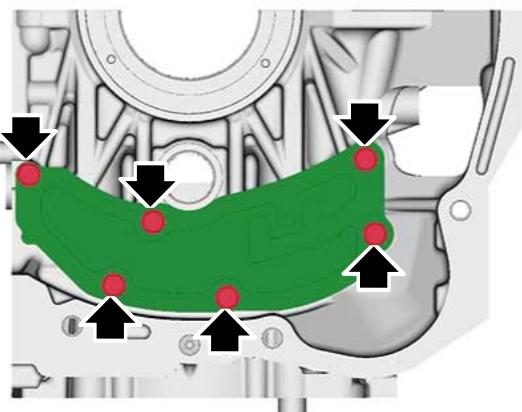
DISASSEMBLY



1. CYLINDER BLOCK

1. Remove the oil separator cover from cylinder block RH.

ZD-8AJ



ME-23448

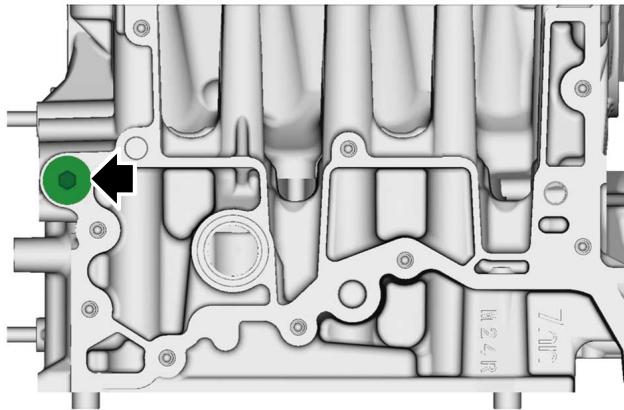
2. Remove the liquid gasket from cylinder block RH.

3. Remove the main gallery plug from cylinder block RH.

Note:

- Perform this procedure only when required.
- After removing the parts, remove the liquid gasket from the thread holes of cylinder block RH and the threaded portion of main gallery plug.

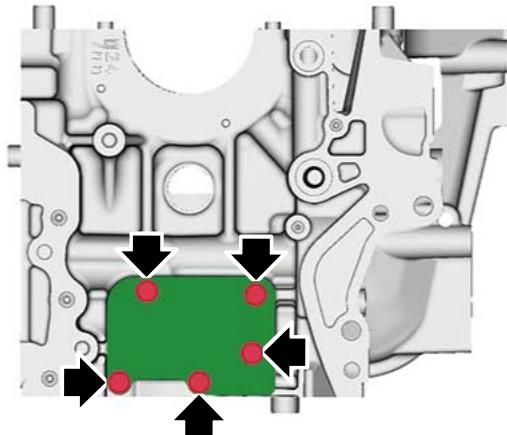
ZD-8AJ



ME-23449

4. Remove the cylinder block plate from cylinder block LH.

ZD-8AJ

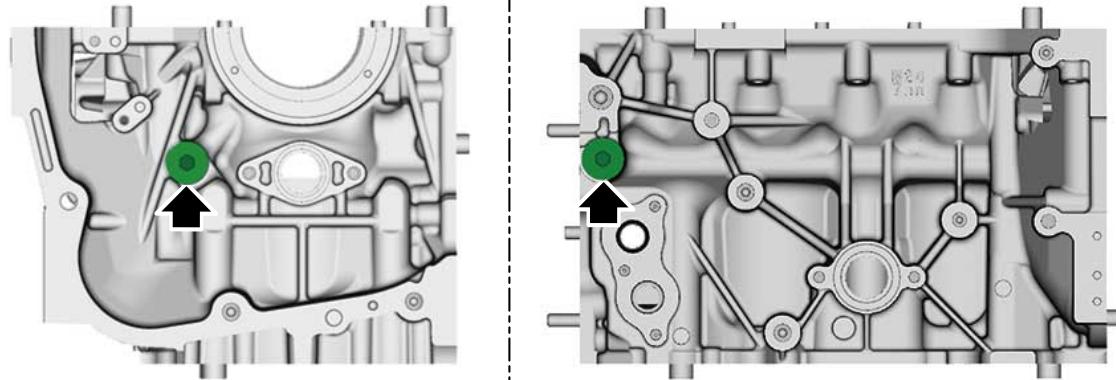


ME-23450

5. Remove the main gallery plug from cylinder block LH.

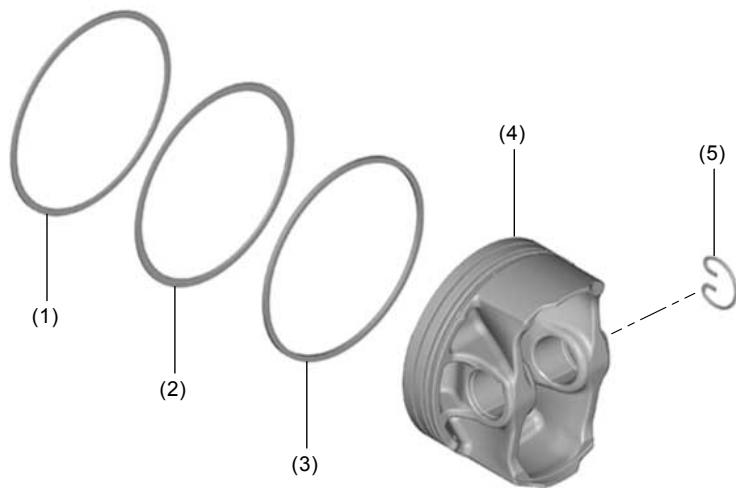
Note:

- Perform this procedure only when required.
- After removing the parts, remove the liquid gasket from the thread holes of the cylinder block LH and main gallery plug.



ME-23451

2. PISTON



ME-23399

- | | | |
|-----------------|--------------|-------------|
| (1) Top ring | (3) Oil ring | (5) Circlip |
| (2) Second ring | (4) Piston | |

1. Remove the piston rings from the piston.

Note:

Arrange the piston rings in order so that they can be installed in their original positions without confusion.

- (1) Remove the compression rings in the order of top ring and second ring, using piston ring expander.
- (2) Remove the oil rings in the order of upper rail, lower rail and expander by hand.

2. Remove the circlip from the piston using long-nose pliers.

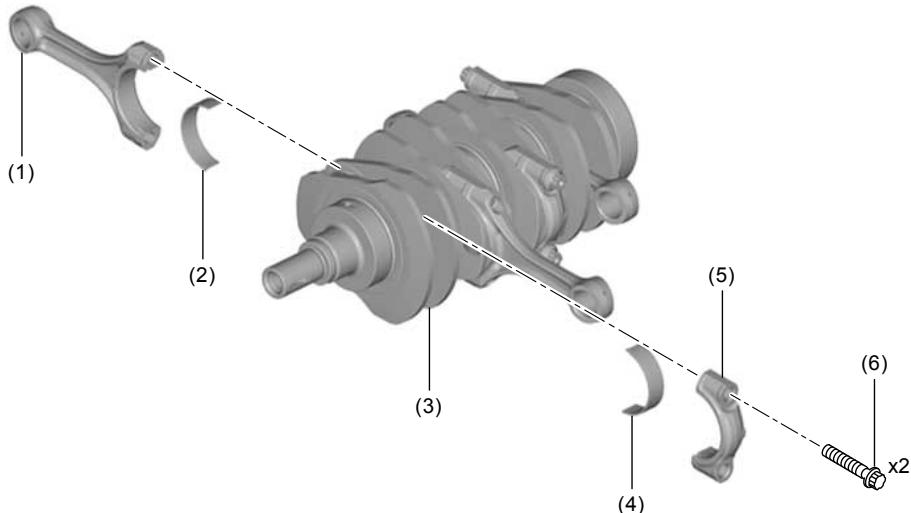
3. CONNECTING ROD & CRANKSHAFT

Caution:

Once the connecting rod is removed from the crankshaft used after engine is started, the connecting rod cannot be reused. Do not remove the connecting rod unless it is to be replaced.

Note:

This section describes the removal procedure for replacement of the #1 connecting rod. When replacing the #2, #3 and #4 connecting rods, use the same removal procedure.



ME-23401

- | | | |
|----------------------------|----------------------------|-----------------------------|
| (1) Connecting rod | (3) Crankshaft | (5) Connecting rod cap |
| (2) Connecting rod bearing | (4) Connecting rod bearing | (6) Connecting rod cap bolt |

1. Using the ST, loosen the connecting rod cap bolts gradually and evenly, and remove the #1 connecting rod cap bolts, #1 connecting rod and #1 connecting rod cap.

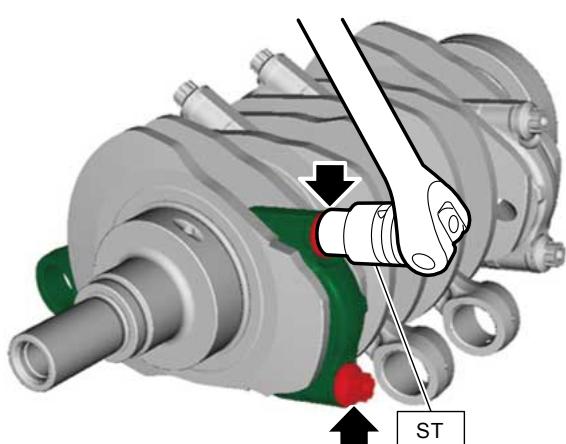
Caution:

- Make sure to hold the crankshaft securely during work.
- When holding the crankshaft, be careful not to damage the crankshaft.

Preparation tool:

ST: SOCKET (E16) (18270KA010)

ZD-8AJ



ME-23452

MECHANICAL(H4DO) > Cylinder Block

ASSEMBLY

1. CYLINDER BLOCK

1. Apply liquid gasket to the threaded portion of the main gallery plug, and install the main gallery plug to the cylinder block RH.

Note:

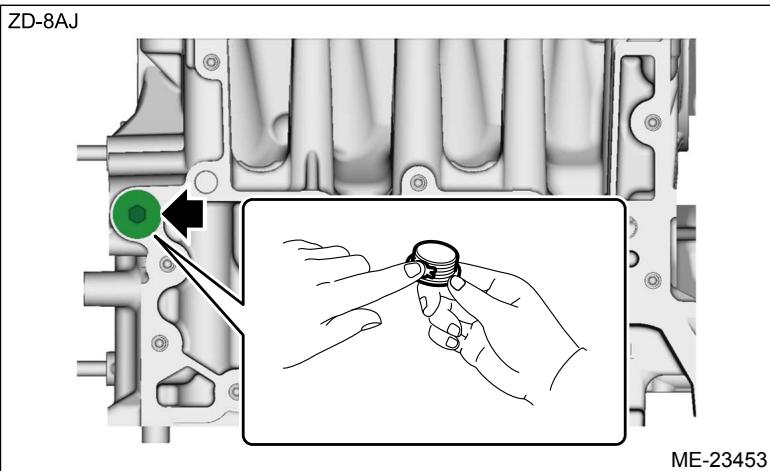
Before applying liquid gasket, degrease the thread holes of the cylinder block RH and main gallery plug.

Preparation items:

Liquid gasket: THREE BOND 1105 (part No. 004403010) or equivalent

Tightening torque:

37 N·m (3.8 kgf-m, 27.3 ft-lb)



2. Install the oil separator cover to the cylinder block RH.

- (1) Apply liquid gasket to the mating surfaces of oil separator cover.

Caution:

Use a new oil separator cover.

Note:

- **Before applying liquid gasket, degrease the old liquid gasket seal surface of cylinder block RH.**
- **Install within 5 min. after applying liquid gasket.**

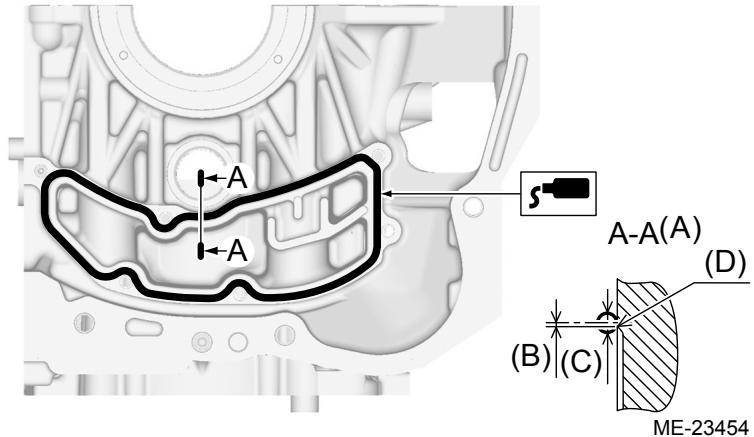
Preparation items:

Liquid gasket: THREE BOND 1217G (part No. K0877Y0100), THREE BOND 1217H or equivalent

Liquid gasket applying diameter:

$4 \pm 1 \text{ mm}$ ($0.1575 \pm 0.0197 \text{ in}$)

ZD-8AJ



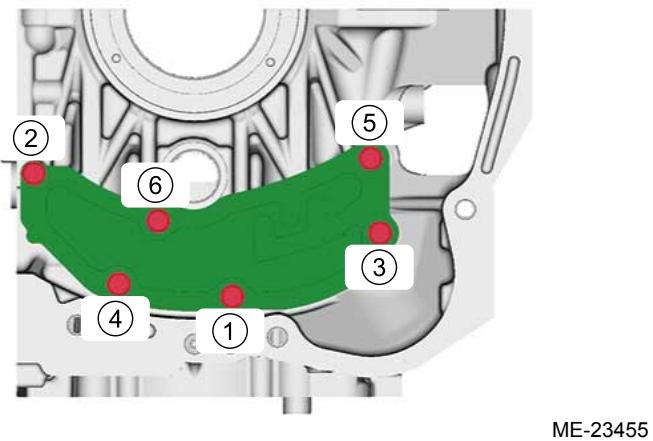
- (A) Liquid gasket applying position of mating surface
(B) Within 1 mm (0.0394 in)
(C) $\phi 4 \pm 1$ mm
 (0.1772 \pm 0.0394 in)
(D) Chamfer edge

(2) Install the oil separator cover to the cylinder block RH, and tighten the oil separator cover bolts in numerical order as shown in the figure.

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

ZD-8AJ



3. Apply liquid gasket to the threaded portion of the main gallery plug, and install the main gallery plug to the cylinder block LH.

Note:

Before applying liquid gasket, degrease the thread holes of the cylinder block LH and main gallery plug.

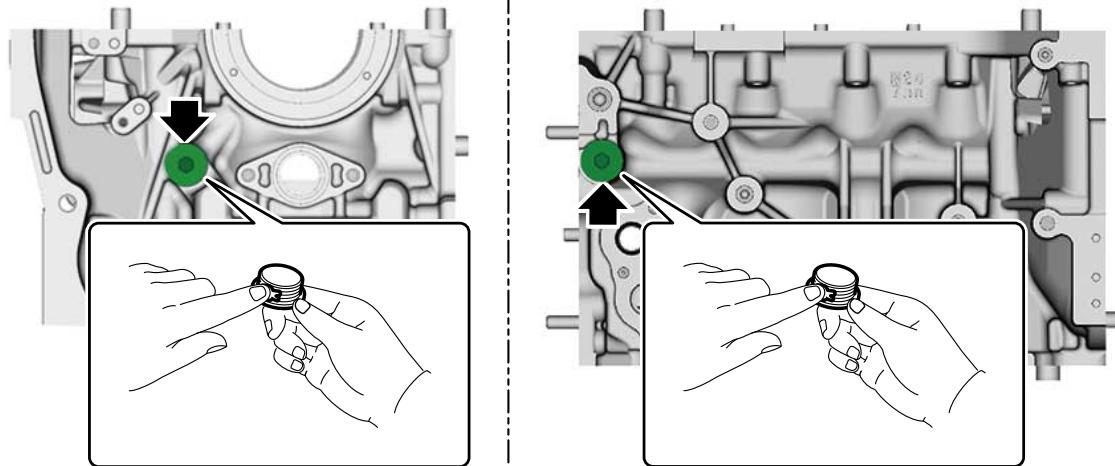
Preparation items:

Liquid gasket: THREE BOND 1105 (part No. 004403010) or equivalent

Tightening torque:

37 N·m (3.8 kgf-m, 27.3 ft-lb)

ZD-8AJ



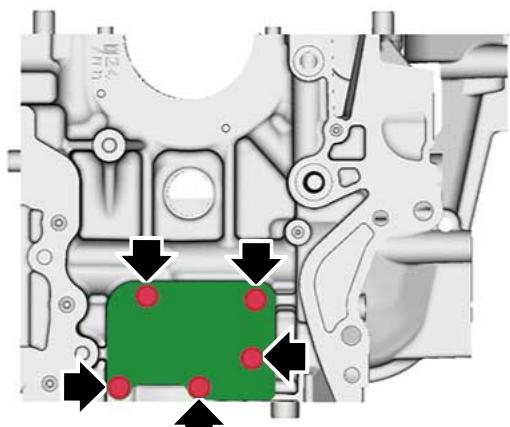
ME-23456

4. Install the cylinder block plate onto cylinder block LH.

Tightening torque:

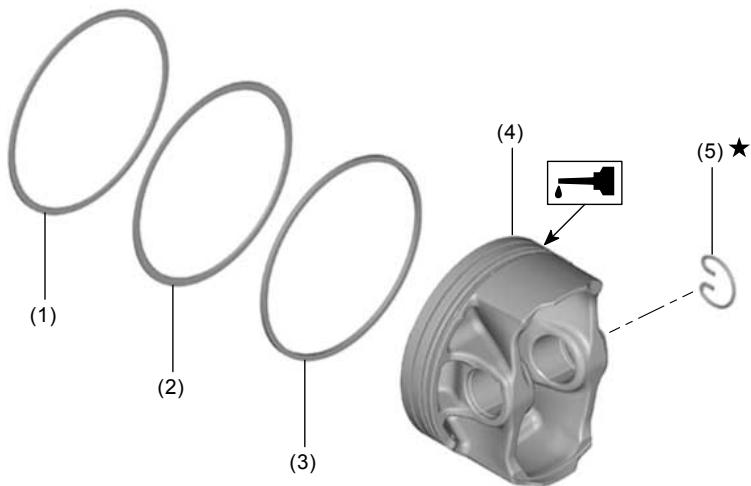
6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

ZD-8AJ



ME-23450

2. PISTON



ME-23400

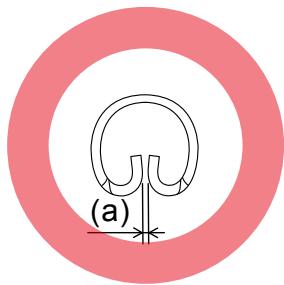
- | | | |
|-----------------|--------------|-------------|
| (1) Top ring | (3) Oil ring | (5) Circlip |
| (2) Second ring | (4) Piston | |

1. Install a new circlip on only one side of the piston using long-nose pliers.

Caution:

- When installing the circlip using long-nose pliers, do not allow the circlip claw sections to contact with each other as shown in the figure.

ZD-8AJ



○=OK



⊖=NG

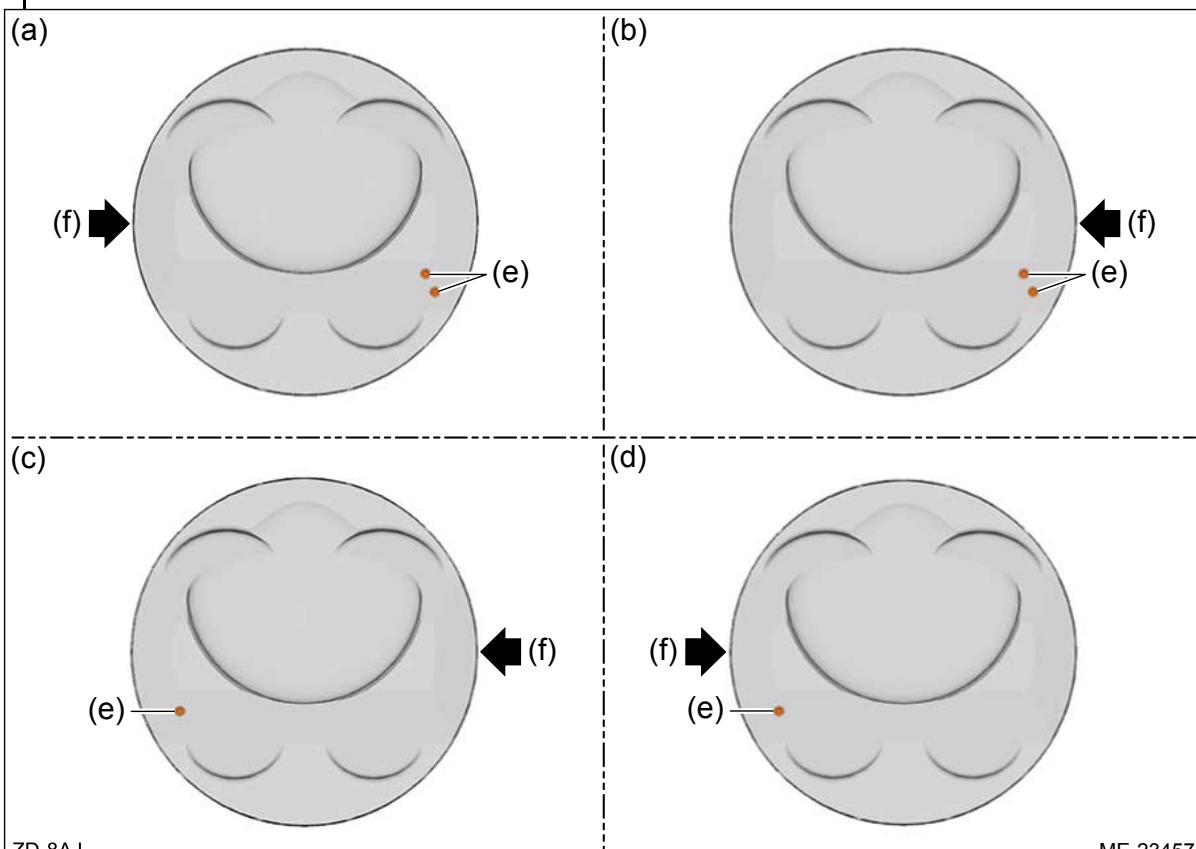
ME-23442

- (a) Gap between the circlip claw sections: 1 mm (0.0394 in) or more

- After operation, make sure the circlip is firmly installed on the circlip groove of the piston.
- If the circlip needs to be reinstalled after installed to the piston, the circlip cannot be reused. Use a new circlip.

Note:

The circlip installation position is determined depending on the position of cylinder to be used. Be careful not to mistake the position.

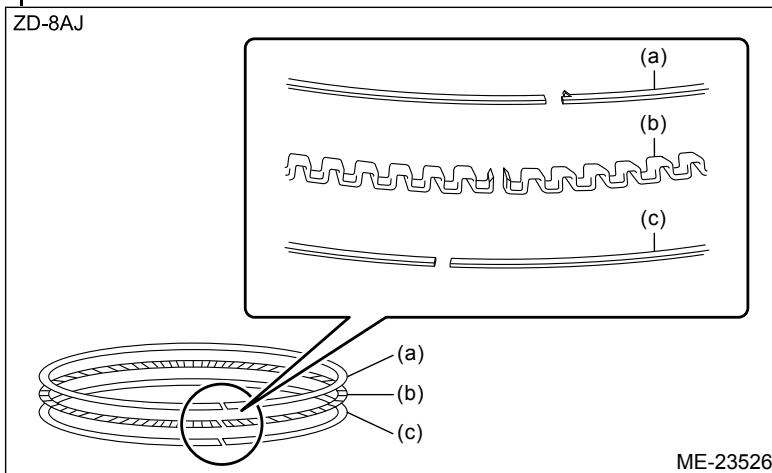


- | | | |
|---------------------------|---------------------------|-----------------------------------|
| (a) Piston of #1 cylinder | (c) Piston of #2 cylinder | (e) Front mark |
| (b) Piston of #3 cylinder | (d) Piston of #4 cylinder | (f) Circlip installation position |

2. Install the oil rings to the piston in the order of expander, lower rail and upper rail by hand.

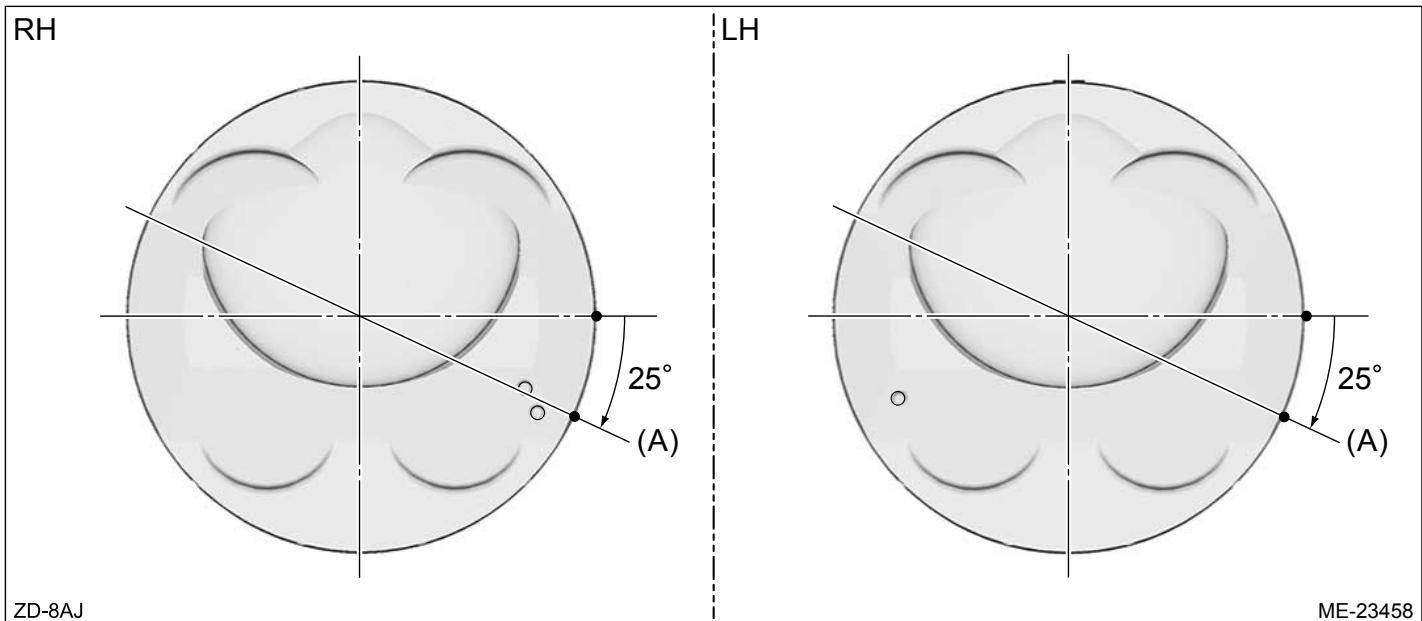
Note:

Oil ring consists of the upper rail, expander and lower rail.

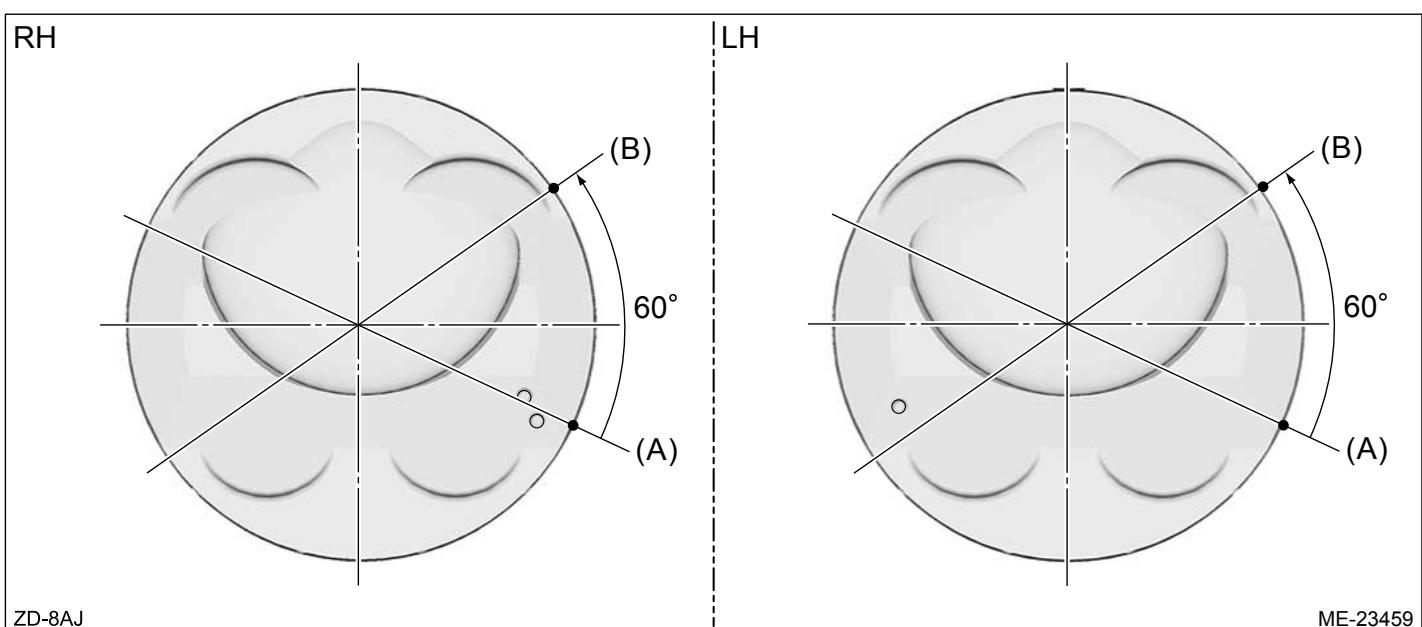


- | | | |
|----------------|--------------|----------------|
| (a) Upper rail | (b) Expander | (c) Lower rail |
|----------------|--------------|----------------|

(1) Set the ring gap of the expander to the position (A).



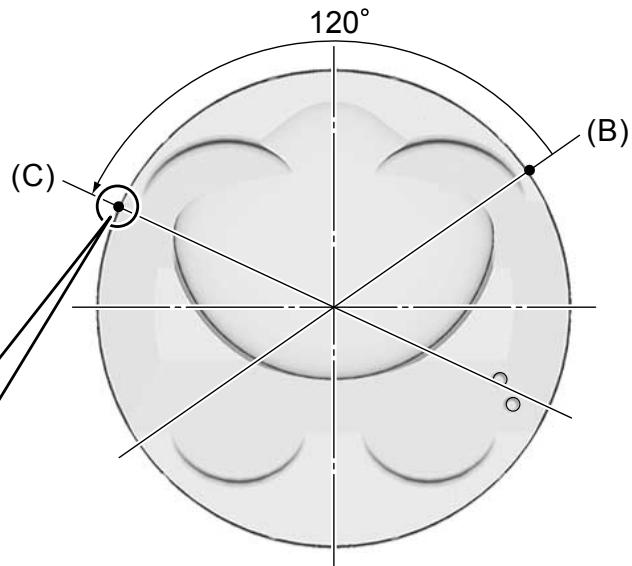
(2) Set the ring gap of the lower rail at position (B), located 60° counterclockwise from the position (A) in the figure.



(3) Set the ring gap of the upper rail at position (C), located 120° counterclockwise from the position (B) in the figure, and align the upper rail spin stopper (E) to the side hole (D) on the piston.

- RH side

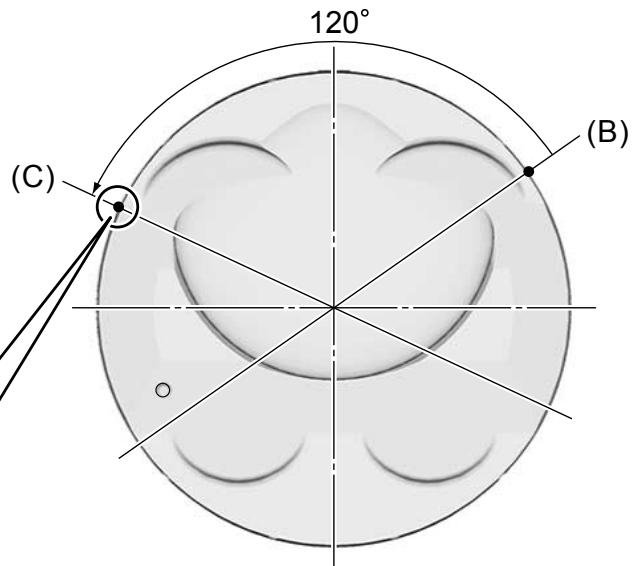
ZD-8AJ



ME-23460

- LH side

ZD-8AJ



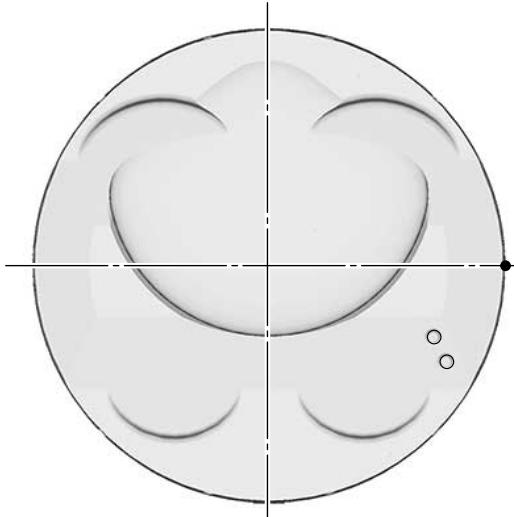
ME-23461

- 3.** Install the compression rings to the piston in the order of second ring and top ring, using piston ring expander.
(1) Set the ring gap of the second ring to the position (A) in the figure.

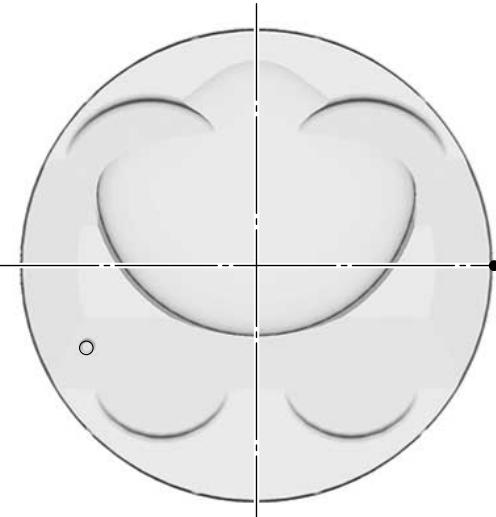
Note:

The ring mark (2BZ) on the second ring should face the piston crown.

RH



LH



ZD-8AJ

ME-23462

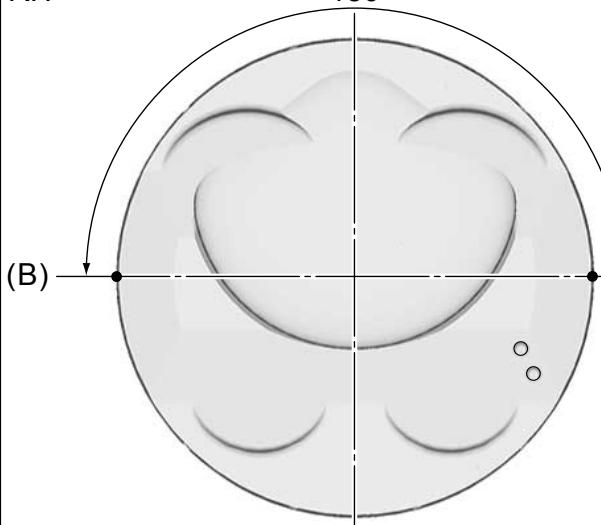
- (2) Set the ring gap of top ring at (B) in the figure on the 180° opposite direction of (A).

Note:

The ring mark (1BZ) of the top ring should face the piston crown.

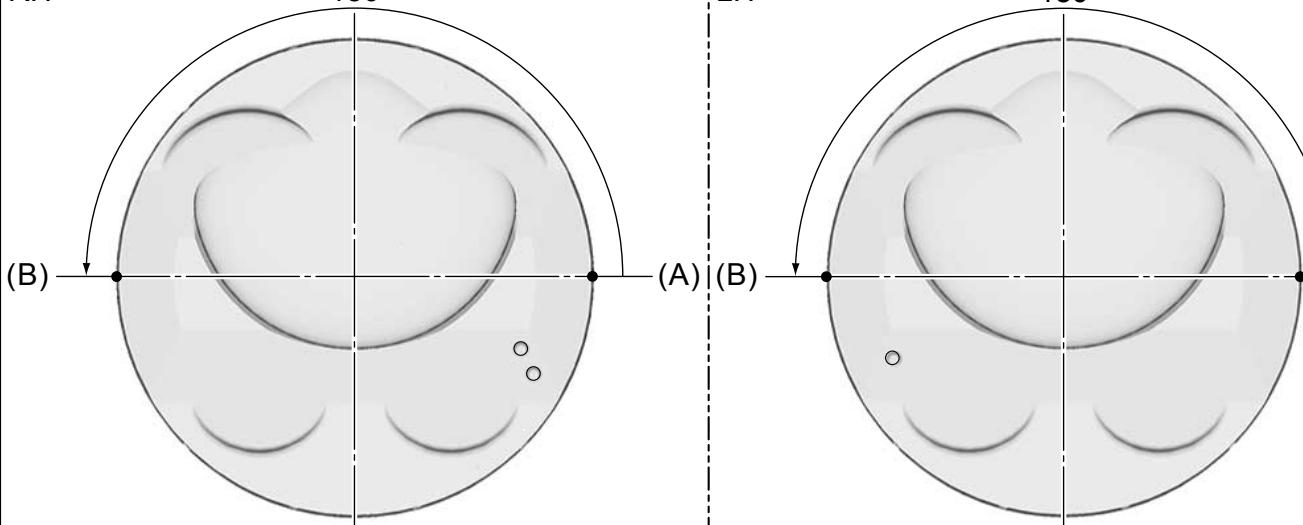
RH

180°



LH

180°



ZD-8AJ

ME-23463

4. Check again that the piston rings are installed correctly.

Note:

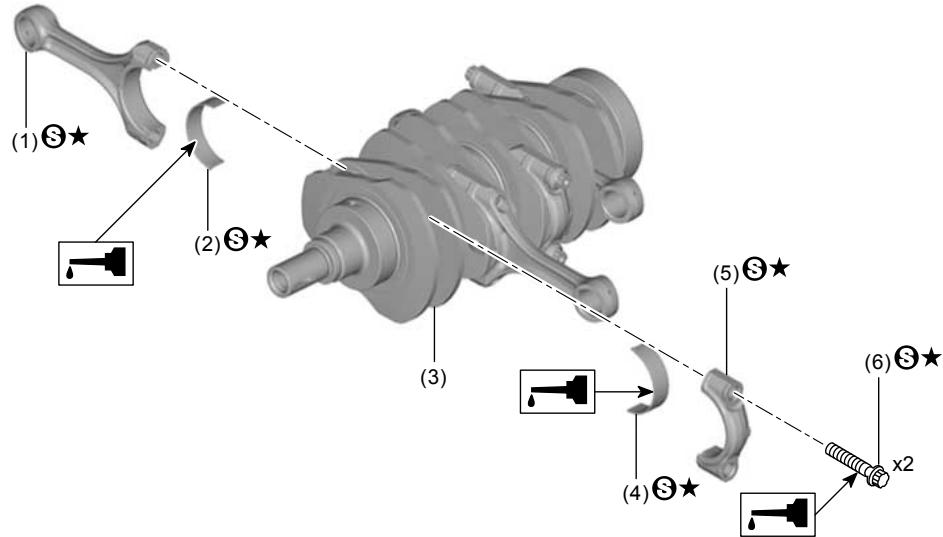
Also check that the ring gaps is not positioned within the range of piston skirt extended line.

3. CONNECTING ROD & CRANKSHAFT

Note:

This section describes the installation procedure for replacement of the #1 connecting rod.

When replacing the #2, #3 and #4 connecting rods, use the same installation procedure.



ME-23402

- | | | |
|----------------------------|----------------------------|-----------------------------|
| (1) Connecting rod | (3) Crankshaft | (5) Connecting rod cap |
| (2) Connecting rod bearing | (4) Connecting rod bearing | (6) Connecting rod cap bolt |

1. Clean the #1 pin of crankshaft, and apply engine oil to the #1 pin of crankshaft.
2. Set the #1 connecting rod bearing to the #1 connecting rod and #1 connecting rod cap.

Caution:

Use a new set of connecting rod & connecting rod bearing or a set before engine start.

Note:

- The connecting rod & connecting rod bearing set is a set of connecting rod, connecting rod bearing, connecting rod cap, and connecting rod cap bolt.
- For replacement of the connecting rod & connecting rod bearing set, refer to the inspection in "Connecting rod & crankshaft".  [Ref. to MECHANICAL\(H4DO\)>Cylinder Block>INSPECTION > CONNECTING ROD & CRANKSHAFT.](#)

3. Set the #1 connecting rod, #1 connecting rod cap and #1 connecting rod cap bolt to the #1 pin of crankshaft.

Note:

- Each connecting rod has its own mating cap. Make sure that they are assembled correctly by checking their identification mark (symbol).
- Install the connecting rod with its side with the identification mark (symbol) facing the engine lower side (exhaust side).
- Apply a coat of engine oil to the connecting rod cap bolt thread.

4. Using ST, tighten the #1 connecting rod cap bolts.

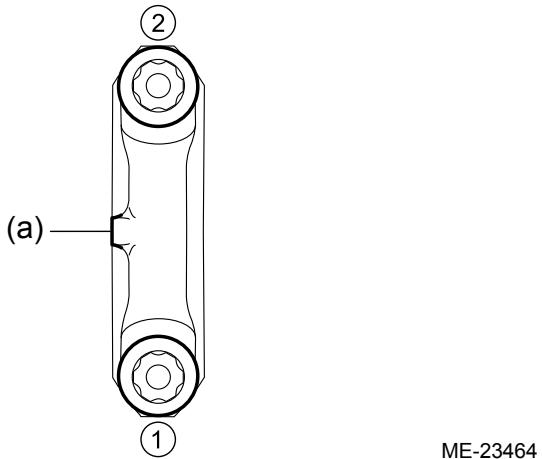
Caution:

- Make sure to hold the crankshaft securely during work.
- When holding the crankshaft, be careful not to damage the crankshaft.

Note:

Tighten the connecting rod cap bolts in numerical order as shown in the figure when the protrusion (a) of the connecting rod cap is at the position shown in the figure.

ZD-8AJ



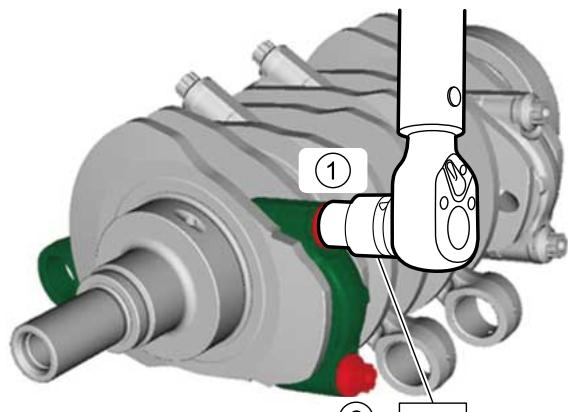
ME-23464

Preparation tool:

ST: SOCKET (E16) (18270KA010)

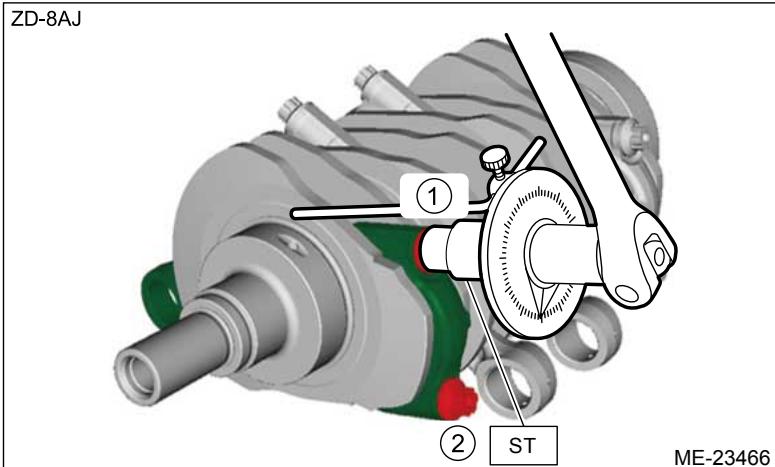
- (1) Tighten the connecting rod cap bolts to 10 N·m (1.0 kgf-m, 7.4 ft-lb) in numerical order as shown in the figure, then retighten the bolts to 34 N·m (3.5 kgf-m, 25.1 ft-lb) in numerical order as shown in the figure.

ZD-8AJ



ME-23465

- (2) Using the angle gauge, tighten the connecting rod cap bolts with torque of 115 – 125 ° in numerical order as shown in the figure.



MECHANICAL(H4DO) > Cylinder Block

INSPECTION

1. CYLINDER BLOCK & PISTON

1. Visually inspect to make sure that there are no cracks, scratches or other damage.
2. Use liquid penetrant tester on the important sections to check for fissures.
3. Check that there are no traces of gas leaking or water leaking on the gasket attachment surface.
4. Check the oil passages for clogging.
5. Check for warpage of mating surfaces of the cylinder block that contacts cylinder head using a straight edge and thickness gauge. If it exceeds the limit, correct the surface by grinding it with a surface grinder or replace the cylinder block.

Note:

Measurement should be performed at a temperature of 20°C (68°F).

Cylinder block warpage:

Limit

0.025 mm (0.0010 in)

Grinding limit of cylinder block:

204.95 mm (8.0689 in) or less

Height of cylinder block:

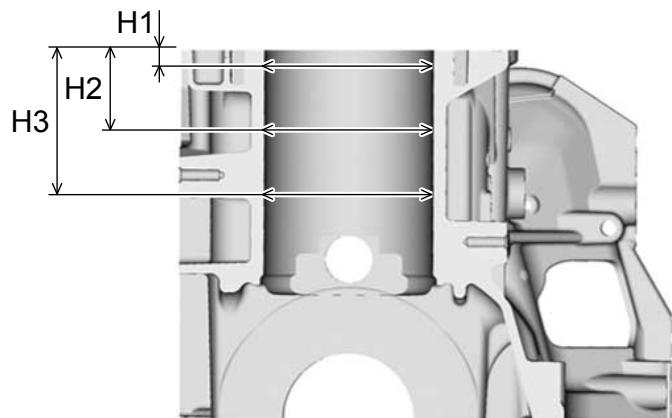
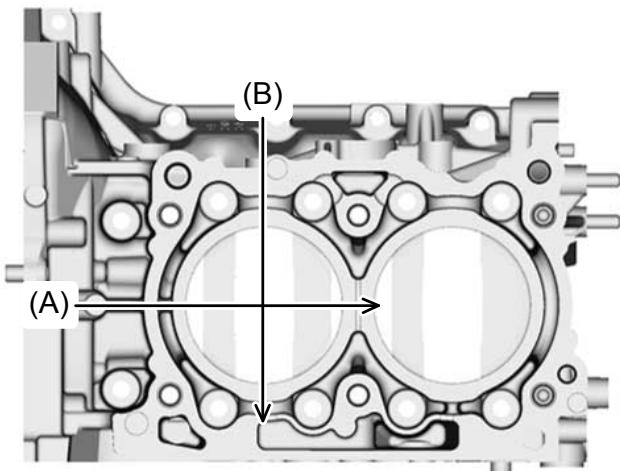
Standard

205.0 mm (8.0709 in)

6. Using a cylinder bore gauge, check the cylindricality and out-of-roundness of cylinder liner. If the limit is exceeded, perform reboring (including honing), or replace the cylinder block and piston as a set. For reboring and honing procedure, refer to step 8.

Note:

- **Measure the cylinder liner with cylinder blocks separated (into cylinder block RH and cylinder block LH).**
- **Measurement should be performed at a temperature of 20°C (68°F).**
- **Write down all measurement values as the values are used in the next procedure.**
- **Measure the inner diameter of each cylinder liner in both the piston pin and thrust directions at the heights as shown in the figure.**



ME-23467

(A) Piston pin direction

(B) Thrust direction

H1: 10 mm (0.3937 in)

H2: 45 mm (1.7717 in)

H3: 80 mm (3.1496 in)

- Calculate the cylindricality of cylinder liner by using the following formula.**

Calculation formula

 $C = \text{The larger value between the calculation values } C' \text{ and } C''$ $C' = (D(a) - D(b))/2$ $C'' = (D(c) - D(d))/2$

C: Cylindricality of cylinder liner

D (a): The largest value of all the values obtained by measuring in the direction of the piston pin

D (b): The smallest value of all the values obtained by measuring in the direction of the piston pin

D (c): The largest value of all the values obtained by measuring in the thrust direction

D (d): The smallest value of all the values obtained by measuring in the thrust direction

- Calculate the out-of-roundness of cylinder liner at each measurement height by using the following formula.**

Calculation formula

 $R = (D(e) - D(f))/2$

R: Out-of-roundness of cylinder liner

D (e): The larger value between the measurement values in the piston pin direction and in the thrust direction

D (f): The smaller value between the measurement values in the piston pin direction and in the thrust direction

- When the cylinder block is replaced, the main journal size mark may be changed and it may be also necessary to replace the crankshaft bearing with a new part. For details on the crankshaft bearing, refer to step 5. in "Crankshaft & crankshaft bearing", and select the crankshaft bearing of suitable size when replacement is required.** [Ref. to MECHANICAL\(H4DO\)>Cylinder Block>INSPECTION > CRANKSHAFT AND CRANKSHAFT](#)

BEARING.

Cylindricality of cylinder liner:

Limit

0.030 mm (0.0012 in)

Out-of-roundness of cylinder liner:

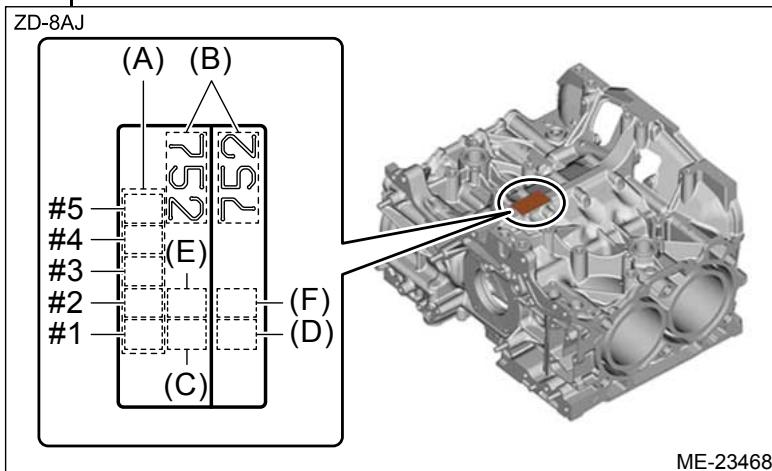
Limit

0.030 mm (0.0012 in)

7. Check the clearance between cylinder liner and piston. Check the clearance between cylinder liner and piston by measuring the inner diameter of cylinder liner and the outer diameter of piston respectively.
- (1) Measure the inner diameter of cylinder liner. If they are not within the standard, perform reboring (including honing), or replace the cylinder block and piston as a set. For reboring and honing procedure, refer to step 8.

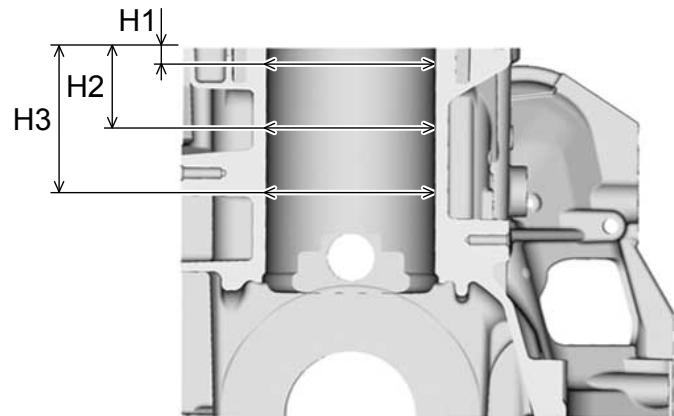
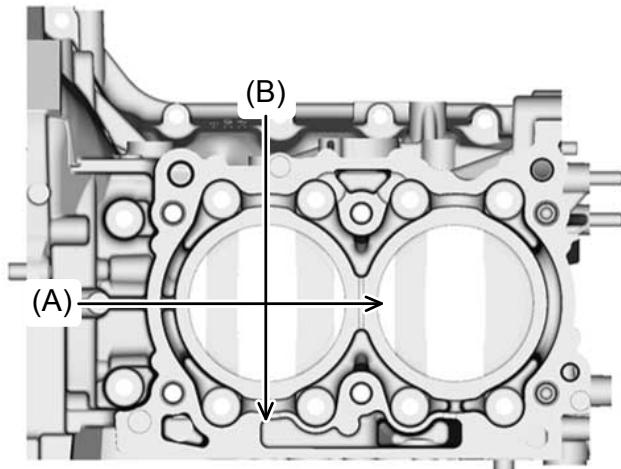
Note:

- **Measure the cylinder liner with cylinder blocks separated (into cylinder block RH and cylinder block LH).**
- **Measurement should be performed at a temperature of 20°C (68°F).**
- **The cylinder bore size mark is stamped on the upper face of the cylinder block.**



- | | | |
|---|--------------------------------------|-------------------------------------|
| (A) Main journal size mark | (C) RH front cylinder bore size mark | (E) RH rear cylinder bore size mark |
| (B) Cylinder block (RH) – (LH) combination mark | (D) LH front cylinder bore size mark | (F) LH rear cylinder bore size mark |

- **Measure the inner diameter of each cylinder liner in both the thrust and piston pin directions at the heights as shown in the figure and read the value of the most worn location.**



ME-23467

(A) Piston pin direction

(B) Thrust direction

H1: 10 mm (0.3937 in)

H2: 45 mm (1.7717 in)

H3: 80 mm (3.1496 in)

- When the cylinder block is replaced, the main journal size mark may be changed and it may be also necessary to replace the crankshaft bearing with a new part. For details on the crankshaft bearing, refer to step 5. in "Crankshaft & crankshaft bearing", and select the crankshaft bearing of suitable size when replacement is required. [Ref. to MECHANICAL\(H4DO\)>Cylinder Block>INSPECTION > CRANKSHAFT AND CRANKSHAFT BEARING.](#)

Inner diameter of cylinder liner:

Cylinder bore size mark A

Standard

94.005 – 94.015 mm (3.7010 – 3.7014 in)

Cylinder bore size mark B

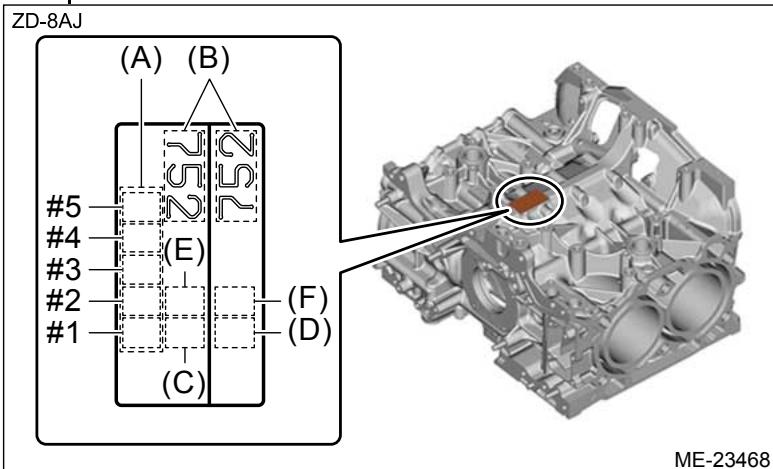
Standard

93.995 – 94.005 mm (3.7006 – 3.7010 in)

- (2) Check the outer diameter of piston with a micrometer. If it is not within the standard, replace the piston.

Note:

- Measurement should be performed at a temperature of 20°C (68°F).
- Measure the outer diameter of each piston in thrust direction at the height as shown in the figure.
- Standard sized pistons are classified into two grades, "A" and "B". These grades should be used as guide lines in selecting a standard piston.
- The grade can be judged by the stamp of cylinder bore size mark on the upper face of the cylinder block.



- | | | |
|---|--------------------------------------|-------------------------------------|
| (A) Main journal size mark | (C) RH front cylinder bore size mark | (E) RH rear cylinder bore size mark |
| (B) Cylinder block (RH) – (LH) combination mark | (D) LH front cylinder bore size mark | (F) LH rear cylinder bore size mark |

- If the piston is replaced, check the clearance between cylinder liner and piston in the step (3), and select a suitable sized piston.

Piston grade point H:

35.9 mm (1.4134 in)

Piston outer diameter:

Standard size (grade A = cylinder bore size mark A)

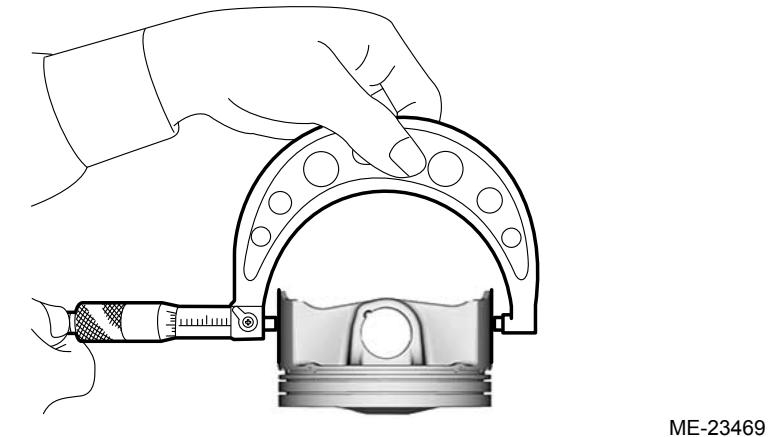
Standard

93.985 – 93.995 mm (3.7002 – 3.7006 in)

Standard size (grade B = cylinder bore size mark B)

Standard

93.975 – 93.985 mm (3.6998 – 3.7002 in)



- (3) Calculate the clearance between cylinder liner and piston. If they are not within the standard, perform reboring (including honing), or replace the cylinder block and piston as a set. For reboring and honing procedure, refer to step 8.

Note:

- The clearance between cylinder liner and piston is decided by matching the cylinder block bore size mark and the grade of piston outer diameter (grade A or B).
- When the cylinder block is replaced, the main journal size mark may be changed and it may be also necessary to replace the crankshaft bearing with a new part. For details on the crankshaft bearing, refer to step 5. in "Crankshaft & crankshaft bearing", and select the crankshaft bearing of suitable size when replacement is required.  [Ref. to MECHANICAL\(H4DO\)>Cylinder Block>INSPECTION > CRANKSHAFT AND CRANKSHAFT BEARING.](#)

Clearance between cylinder liner and piston:

Standard

0.010 — 0.030 mm (0.0004 — 0.0012 in)

8. Reboring and honing

- (1) If any of the cylindricality, out-of-roundness, inner diameter or clearance between cylinder liner and piston is out of standard or if there is any damage on the cylinder liner, perform reboring (including honing).

Caution:

When any of the cylinder liner needs reboring, all other cylinder liners must be rebored at the same time, and replaced with proper size pistons.

Oversize piston outer diameter:

0.25 mm (0.0098 in) oversize

Standard

94.225 — 94.245 mm (3.7096 — 3.7104 in)

0.50 mm (0.0197 in) oversize

Standard

94.475 — 94.495 mm (3.7195 — 3.7203 in)

- (2) If the inner diameter of cylinder liner exceeds the limit after reboring (including honing), replace the cylinder block and piston as a set.

Note:

- Immediately after reboring (including honing), the inner diameter of cylinder liner may differ from its real diameter due to temperature rise. Thus, when measuring the inner diameter of cylinder liner, wait until the temperature has cooled to 20°C (68°F).
- For the measurement of the inner diameter of cylinder liner, refer to step 7 - (1).

Inner diameter of cylinder liner boring limit (diameter):

94.505 mm (3.7207 in) or less

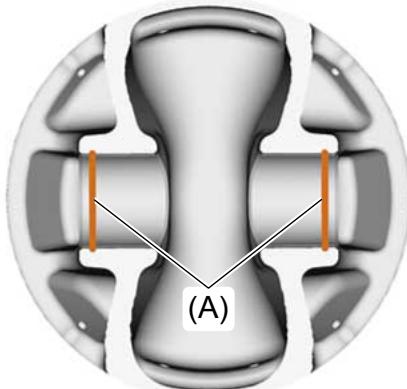
2. PISTON AND PISTON PIN

1. Check the piston and piston pin for wear or crack.
2. Check the piston ring groove for damage.
3. Check the circlip groove (A) for burr.

Note:

If the burr is found, remove the burr from groove.

ZD-8AJ

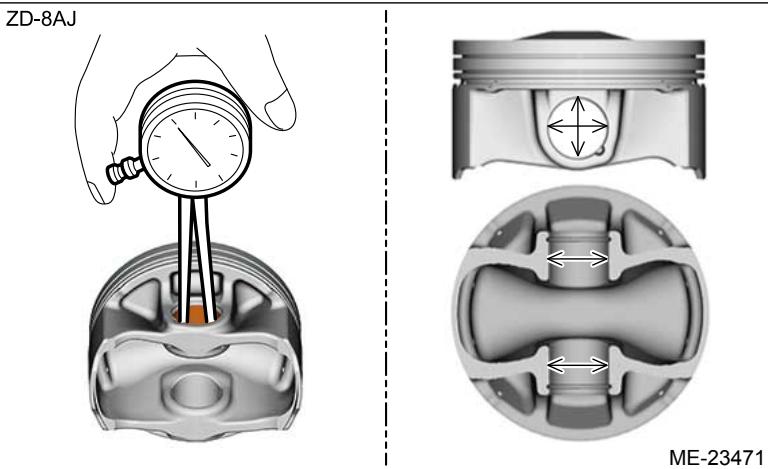


ME-23470

4. Check that the piston pin can be inserted into the piston with a thumb at 20°C (68°F).
5. Check the clearance between piston and piston pin. Check the clearance between piston and piston pin by measuring the inner diameter of piston pin hole and the outer diameter of piston pin respectively. If it is not within the standard, replace the piston and piston pin as a set.
(1) Using a caliper gauge, measure the inner diameter of piston pin hole.

Note:

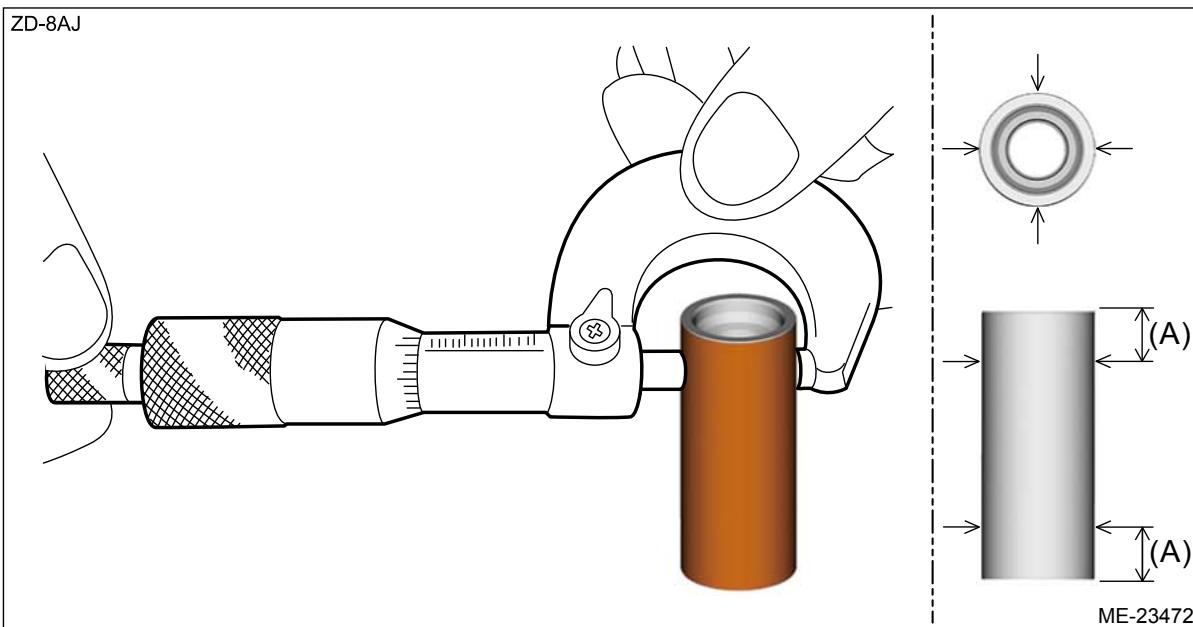
- Measurement should be performed at a temperature of 20°C (68°F).
- Measure the inner diameter of the piston pin hole at the four locations as shown in the figure, and read the value of most worn location.
- Record the measured value.



(2) Measure the outer diameter of piston pin with a micrometer.

Note:

- Measurement should be performed at a temperature of 20°C (68°F).
- Measure the outer diameter of the piston pin at the four locations as shown in the figure, and read the value of most worn location.
- Record the measured value.



(A) 10 mm (0.3937 in)

(3) Calculate the clearance between piston and piston pin.

Clearance between piston and piston pin:

Standard

0.004 — 0.008 mm (0.0002 — 0.0003 in)

3. PISTON RING

1. Make sure the piston ring is not broken or damaged.
2. Using a cylindrical guide, insert the piston ring into the cylinder liner so that they are perpendicular to the cylinder wall, and check the piston ring gap using a thickness gauge. If it is not within the standard,

replace the piston ring.

Note:

- Measurement should be performed at a temperature of 20°C (68°F).
- Use piston ring with same size as piston when replacing piston ring.

Piston ring gap:

Compression ring (top ring)

Standard

0.22 — 0.27 mm (0.0087 — 0.0106 in)

Compression ring (second ring)

Standard

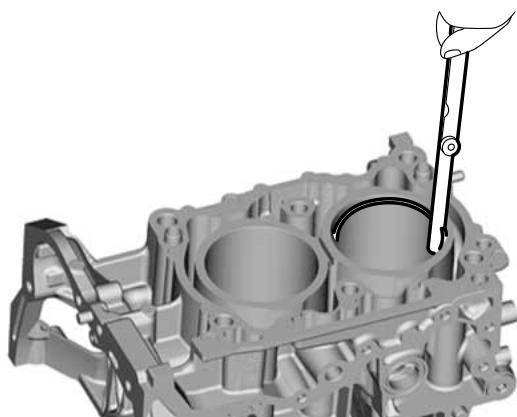
0.35 — 0.45 mm (0.0138 — 0.0177 in)

Oil ring (upper rail and lower rail)

Standard

0.10 — 0.35 mm (0.0039 — 0.0138 in)

ZD-8AJ



ME-23473

3. Fit the compression ring straight into the piston ring groove, then check the clearance between compression ring and piston with a thickness gauge. If it is not within the standard, replace the compression ring.

Note:

- Measurement should be performed at a temperature of 20°C (68°F).
- Before inspecting the clearance, clean the piston ring groove and compression ring.
- Use compression ring with same size as piston when replacing compression ring.

Clearance between compression ring and piston:

Top ring

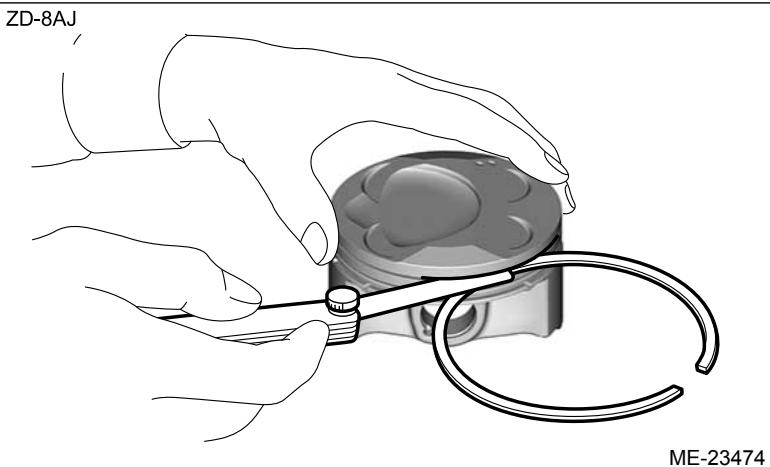
Standard

0.030 — 0.080 mm (0.0012 — 0.0031 in)

Second ring

Standard

0.030 — 0.070 mm (0.0012 — 0.0028 in)



ME-23474

4. CONNECTING ROD & CRANKSHAFT

Note:

- Once the connecting rod is removed from the crankshaft after engine is started, the connecting rod cannot be reused. Do not remove the connecting rod unless it is to be replaced.
- For details on the connecting rod & connecting rod bearing set, refer to step 3. - (4).

- Clean the connecting rod completely, and check it for cracks using liquid penetrant tester.
- Check the thrust clearance of each connecting rod using a thickness gauge. If it is not within the standard, replace the connecting rod & connecting rod bearing set, and replace the crankshaft as required. When replacing the connecting rod & connecting rod bearing set, refer to step 3. - (4).

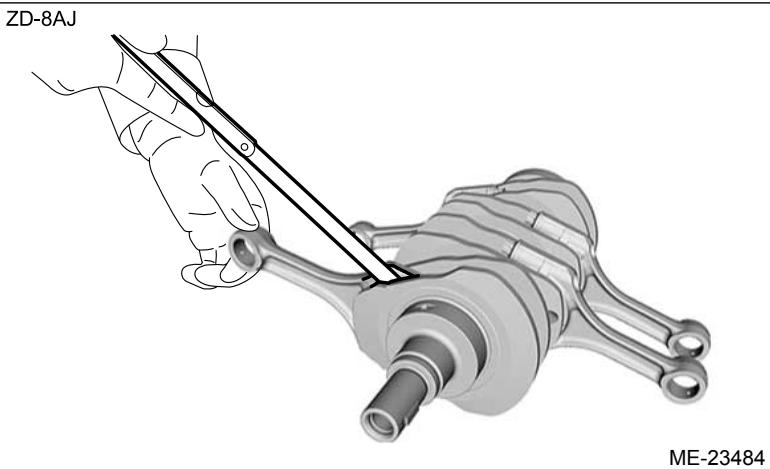
Note:

- Measurement should be performed at a temperature of 20°C (68°F).
- Measure the thrust clearance of each connecting rod at several points, and replace the connecting rod & connecting rod bearing set if there is uneven wear.
- When replacing the crankshaft, check the following items.
 - When replacing the crankshaft, it is also necessary to replace all the connecting rod & connecting rod bearing set and crankshaft bearing that are used after engine is started with new parts.
 - For replacement of the connecting rod & connecting rod bearing set, refer to step 3. - (4).
 - For replacement of the crankshaft bearing, refer to step 5. in "Crankshaft & crankshaft bearing".  Ref. to MECHANICAL(H4DO)>Cylinder Block>INSPECTION > CRANKSHAFT AND CRANKSHAFT BEARING.

Connecting rod thrust clearance:

Standard

0.070 – 0.330 mm (0.0028 – 0.0130 in)



- 3.** Check that each connecting rod has no looseness and that it rotates smoothly. If faulty, perform the following inspections.

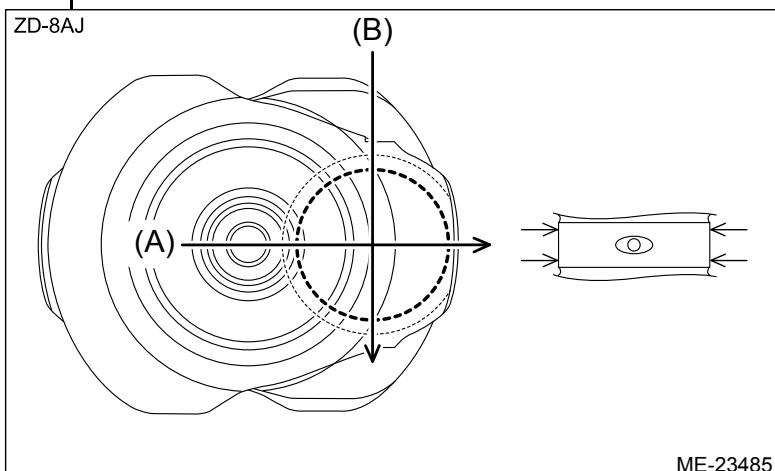
Note:

This step describes the inspection procedure on the assumption that the #1 connecting rod is faulty. When the #2, #3 or #4 connecting rod is faulty, use the same inspection procedure.

- (1) Remove the #1 connecting rod. [Ref. to MECHANICAL\(H4DO\)>Cylinder Block>DISASSEMBLY > CONNECTING ROD & CRANKSHAFT.](#)
- (2) Clean the #1 pin of crankshaft completely, and check the #1 pin of crankshaft for cracks using liquid penetrant tester.
- (3) Using a micrometer, check the outer diameter, cylindricality, and out-of-roundness of the #1 pin of crankshaft. If it exceeds the limit, replace the crankshaft.

Note:

- Measurement should be performed at a temperature of 20°C (68°F).
- For the outer diameter of crankshaft pin, read the value of most worn location of all the measurement values.
- Measure the crankshaft pin outer diameter in the lateral and longitudinal directions at the locations shown in the figure.



(A) Lateral direction

(B) Longitudinal direction

- Calculate the cylindricality of crankshaft pin by using the following formula.

Calculation formula

C = The larger value between the calculation values C' and C''

C' = $(D(a) - D(b))/2$

C'' = $(D(c) - D(d))/2$

C: Cylindricality of crankshaft pin

D (a): The larger value between the measurement values in the lateral direction

D (b): The smaller value between the measurement values in the lateral direction

D (c): The larger value between the measurement values in the longitudinal direction

D (d): The smaller value between the measurement values in the longitudinal direction

- **Calculate the out-of-roundness of crankshaft pin at each measurement locations (2 locations) by using the following formula.**

Calculation formula

R = $(D(e) - D(f))/2$

R: Out-of-roundness of crankshaft pin

D (e): The larger value between the measurement values in the lateral and longitudinal directions

D (f): The smaller value between the measurement values in the lateral and longitudinal directions

- **When replacing the crankshaft, check the following items.**
 - When replacing the crankshaft, it is also necessary to replace all the connecting rod & connecting rod bearing set and crankshaft bearing that are used after engine is started with new parts.
 - For replacement of the connecting rod & connecting rod bearing set, refer to step (4).
 - For replacement of the crankshaft bearing, refer to step 5. in "Crankshaft & crankshaft bearing".  [Ref. to MECHANICAL\(H4DO\)>Cylinder Block>INSPECTION > CRANKSHAFT AND CRANKSHAFT BEARING.](#)

Crankshaft pin:

Cylindricality

Limit

0.006 mm (0.0002 in)

Out-of-roundness

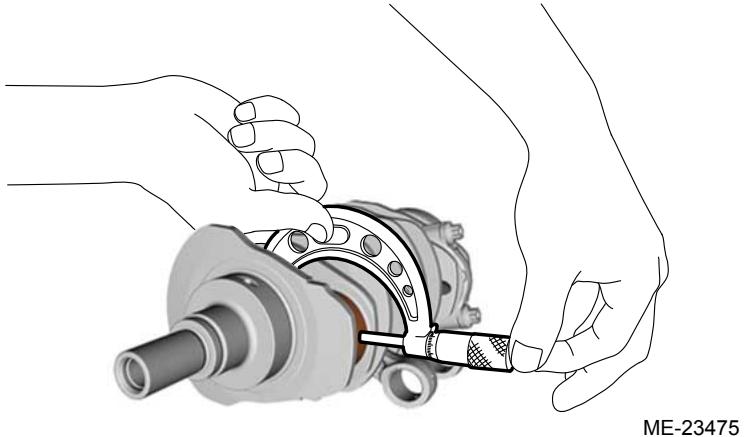
Limit

0.005 mm (0.0002 in)

Service limit (dia.)

51.976 mm (2.0463 in) or less

ZD-8AJ



ME-23475

- (4) Check the oil clearance on the connecting rod (connecting rod bearing) using plastigauge. If it is not within the standard, replace the crankshaft.

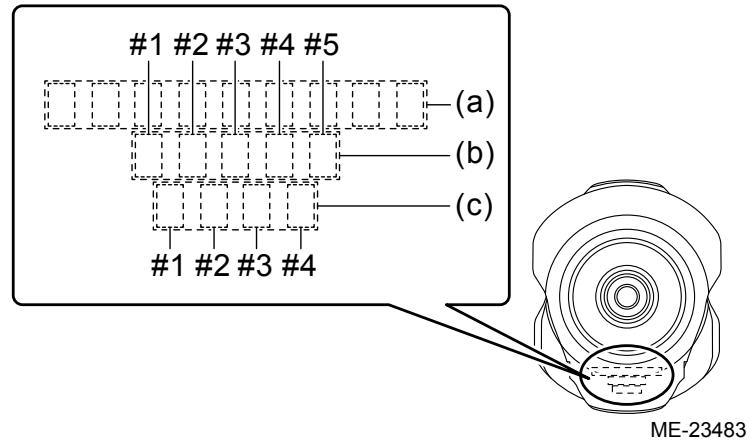
Caution:

Use a new set of connecting rod & connecting rod bearing or a set before engine start.

Note:

- Measurement should be performed at a temperature of 20°C (68°F).
- The connecting rod & connecting rod bearing set is a set of connecting rod, connecting rod bearing, connecting rod cap, and connecting rod cap bolt.
- The connecting rod & connecting rod bearing set can be reused even if it is removed and installed for inspection or other reason, unless it is used before engine is started.
- Select a suitable connecting rod & connecting rod bearing set based on the diameter range of the crankshaft pin stamped on the crankshaft.

ZD-8AJ



ME-23483

(a) Control No.

(b) Diameter range of crankshaft journal

(c) Diameter range of crankshaft pin

Diameter range of crankshaft pin {Crankshaft pin outer diameter}	Selected connecting rod & connecting rod bearing set	Identification color of contained connecting rod bearing
1 {51.992 — 52.000 mm (2.0469 — 2.0472 in)}	STD3	Yellow

2 {51.984 – 51.992 mm (2.0466 – 2.0469 in)}	STD2	Green
3 {51.976 – 51.984 mm (2.0463 – 2.0466 in)}	STD1	Blue

- When replacing the crankshaft, check the following items.
- When replacing the crankshaft, it is also necessary to replace all the connecting rod & connecting rod bearing set and crankshaft bearing that are used after engine is started with new parts.
- When replacing the connecting rod & connecting rod bearing set with a new set, select a suitable connecting rod & connecting rod bearing set by referring to the instructions above. After selecting, refer to the assembly in “Connecting rod & crankshaft”, as no oil clearance check is required for the connecting rod (connecting rod bearing).  [Ref. to MECHANICAL\(H4DO\)>Cylinder Block>ASSEMBLY > CONNECTING ROD & CRANKSHAFT.](#)
- When reusing the connecting rod & connecting rod bearing set before engine start, be sure to check the diameter range of the new crankshaft pin and judge whether it is a reusable connecting rod & connecting rod bearing set. For the diameter range, refer to the instructions above. When reusing the connecting rod & connecting rod bearing set before engine start, refer to the assembly in “Connecting rod & crankshaft” after checking the diameter range, as no oil clearance check is required for the connecting rod (connecting rod bearing).  [Ref. to MECHANICAL\(H4DO\)>Cylinder Block>ASSEMBLY > CONNECTING ROD & CRANKSHAFT.](#)
- For replacement of the crankshaft bearing, refer to step 5. in “Crankshaft & crankshaft bearing”.  [Ref. to MECHANICAL\(H4DO\)>Cylinder Block>INSPECTION > CRANKSHAFT AND CRANKSHAFT BEARING.](#)

- 1) Clean the #1 connecting rod bearing and the #1 pin of crankshaft.
- 2) Set the #1 connecting rod bearing to the #1 connecting rod and #1 connecting rod cap.
- 3) Place a plastigauge across the #1 pin of crankshaft, and set the #1 connecting rod, #1 connecting rod cap and connecting rod cap bolt to the #1 pin of crankshaft.

Note:

- Each connecting rod has its own mating cap. Make sure that they are assembled correctly by checking their identification mark (symbol).
- Install the connecting rod with its side with the identification mark (symbol) facing the engine lower side (exhaust side).
- Apply a coat of engine oil to the connecting rod cap bolt thread.

- 4) Using the ST, after tightening the connecting rod cap bolts, loosen the connecting rod cap bolts, and remove #1 connecting rod, #1 connecting rod cap and connecting rod cap bolts.

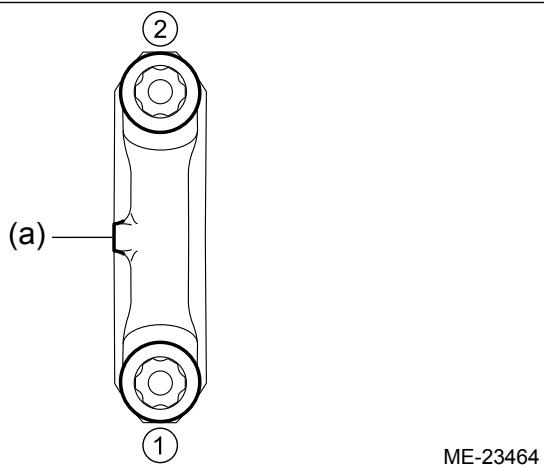
Caution:

- Make sure to hold the crankshaft securely during work.
- When holding the crankshaft, be careful not to damage the crankshaft.
- During the operation, be careful not to move the #1 connecting rod and the #1 connecting rod cap.

Note:

Tighten the connecting rod cap bolts in numerical order as shown in the figure when the protrusion (a) of the connecting rod cap is at the position shown in the figure.

ZD-8AJ



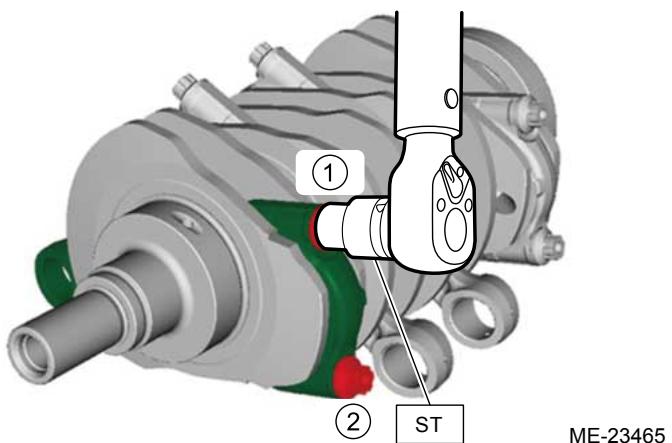
ME-23464

Preparation tool:

ST: SOCKET (E16) (18270KA010)

- a. Tighten the connecting rod cap bolts to 10 N·m (1.0 kgf-m, 7.4 ft-lb) in numerical order as shown in the figure, then retighten the bolts to 34 N·m (3.5 kgf-m, 25.1 ft-lb) in numerical order as shown in the figure.

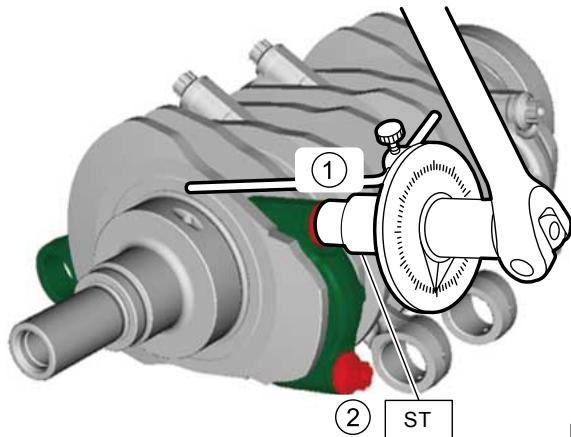
ZD-8AJ



ME-23465

- b. Using the angle gauge, tighten the connecting rod cap bolts with torque of 115 — 125 ° in numerical order as shown in the figure.

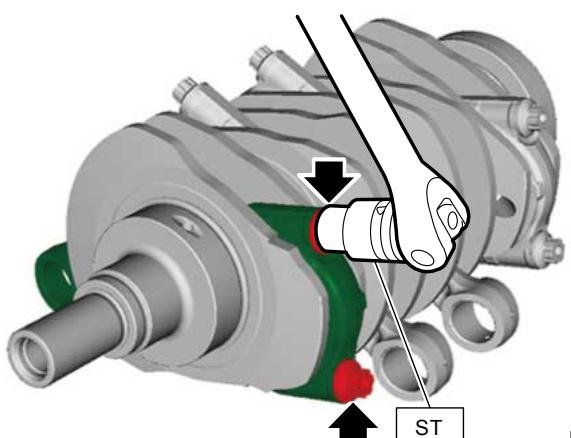
ZD-8AJ



ME-23466

- c. Loosen the connecting rod cap bolts gradually and evenly, and remove the connecting rod cap bolts, #1 connecting rod and #1 connecting rod cap.

ZD-8AJ



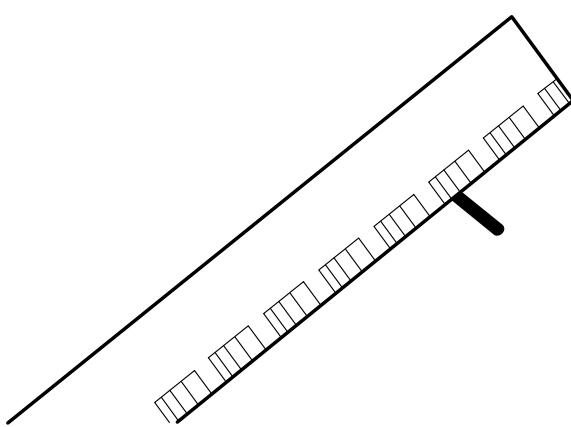
ME-23452

- 5) Determine oil clearance of the #1 connecting rod bearing by matching the widest point of the plastigauge on #1 pin of crankshaft against scale printed on a package of the plastigauge.

Connecting rod bearing oil clearance:

Standard

0.025 – 0.055 mm (0.0010 – 0.0022 in)



ME-23042

- 7) Completely remove the plastigauge.

5. PISTON PIN & CONNECTING ROD BUSHING

Note:

Once the connecting rod is removed from the crankshaft after engine is started, the connecting rod cannot be reused. Do not remove the connecting rod unless it is to be replaced.

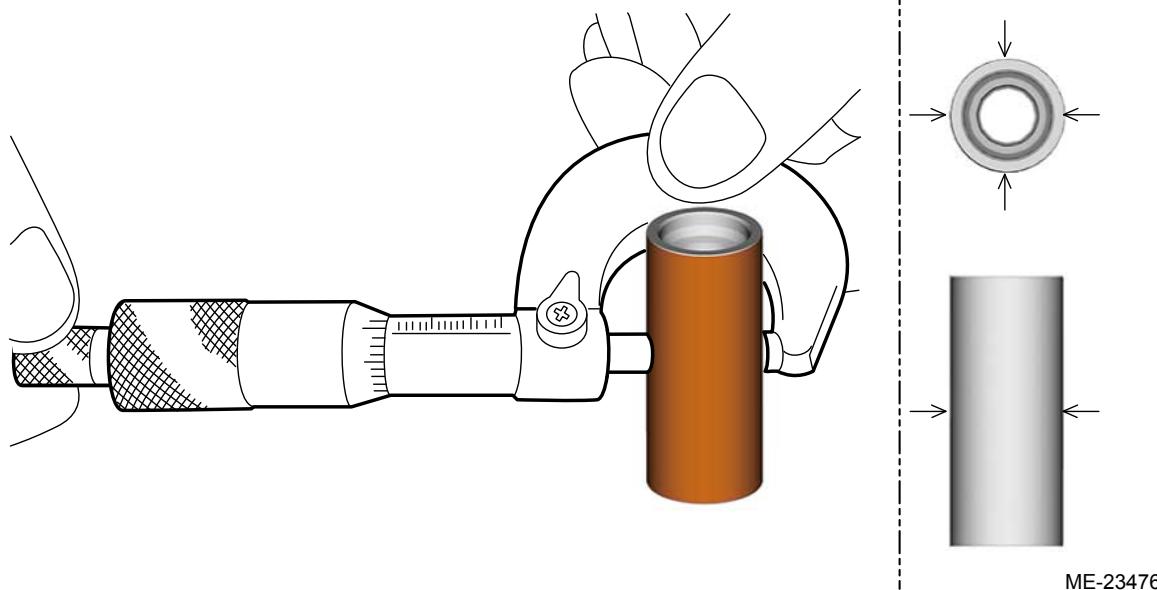
1. Check that the connecting rod bushing is not damaged.
2. Check the clearance between piston pin and connecting rod bushing. Check the clearance between piston pin and connecting rod bushing by measuring the outer diameter of piston pin and the inner diameter of connecting rod bushing respectively. If it is not within the standard, replace the connecting rod & connecting rod bearing set and piston pin as a set. When replacing the connecting rod & connecting rod bearing set, refer to step 3. - (4) in "Connecting rod & crankshaft".  [Ref. to MECHANICAL\(H4DO\)>Cylinder Block>INSPECTION > CONNECTING ROD & CRANKSHAFT.](#)

- (1) Measure the outer diameter of piston pin with a micrometer.

Note:

- Measurement should be performed at a temperature of 20°C (68°F).
- Measure the outer diameter of the piston pin at the two locations as shown in the figure, and read the value of most worn location.
- Record the measured value.

ZD-8AJ



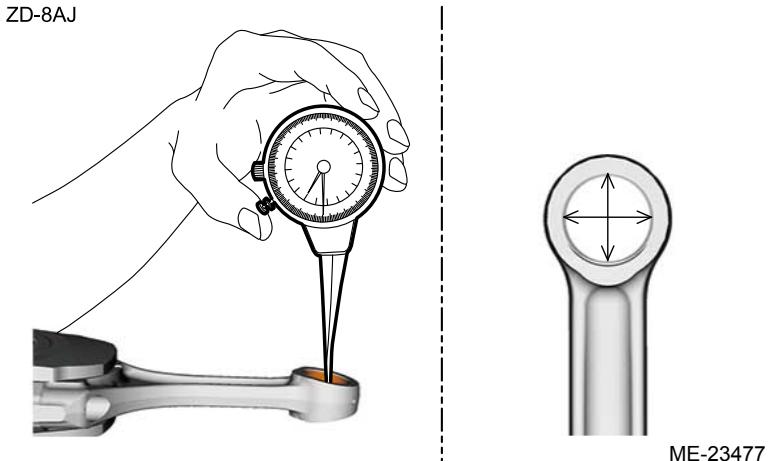
ME-23476

- (2) Using a caliper gauge, measure the inner diameter of connecting rod bushing.

Note:

- Measurement should be performed at a temperature of 20°C (68°F).
- Measure the inner diameter of the connecting rod bushing at the two locations as shown in the figure, and read the value of most worn location.
- Record the measured value.

ZD-8AJ



(3) Calculate the clearance between piston pin and connecting rod bushing.

Clearance between piston pin and connecting rod bushing:

Standard

0.006 — 0.026 mm (0.0002 — 0.0010 in)

6. CRANKSHAFT AND CRANKSHAFT BEARING

Note:

Once the connecting rod is removed from the crankshaft after engine is started, the connecting rod cannot be reused. Do not remove the connecting rod unless it is to be replaced.

1. Clean the crankshaft completely, and check it for cracks using liquid penetrant tester.
2. Using a dial gauge, check the crankshaft bend. If it exceeds the limit, replace the crankshaft.

Caution:

During the check, be careful not to damage the cylinder block by the connecting rod.

Note:

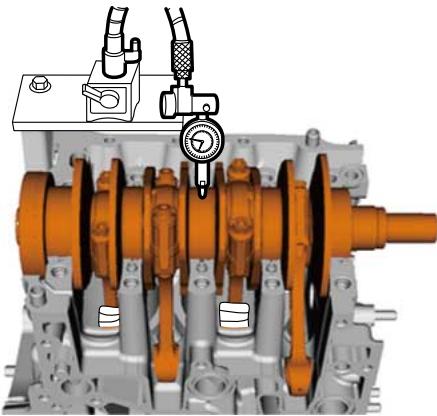
- Measurement should be performed at a temperature of 20°C (68°F).
- Using just the #1 and #5 crankshaft bearings on cylinder block RH, position the crankshaft together with connecting rod on cylinder block. Then, measure the crankshaft bend using a dial gauge.
- When replacing the crankshaft, check the following items.
 - When replacing the crankshaft, it is also necessary to replace all the connecting rod & connecting rod bearing set and crankshaft bearing that are used after engine is started with new parts.
 - For replacement of the connecting rod & connecting rod bearing set, refer to step 3. - (4) in "Connecting rod & crankshaft". Ref. to MECHANICAL(H4DO)>Cylinder Block>INSPECTION > CONNECTING ROD & CRANKSHAFT.
 - For replacement of the crankshaft bearing, refer to step 5.

Crankshaft bend:

Limit

0.035 mm (0.0014 in)

ZD-8AJ



ME-23478

- 3.** Using a micrometer, check the outer diameter, cylindricality, and out-of-roundness of the crankshaft journal. If it exceeds the limit, replace the crankshaft.

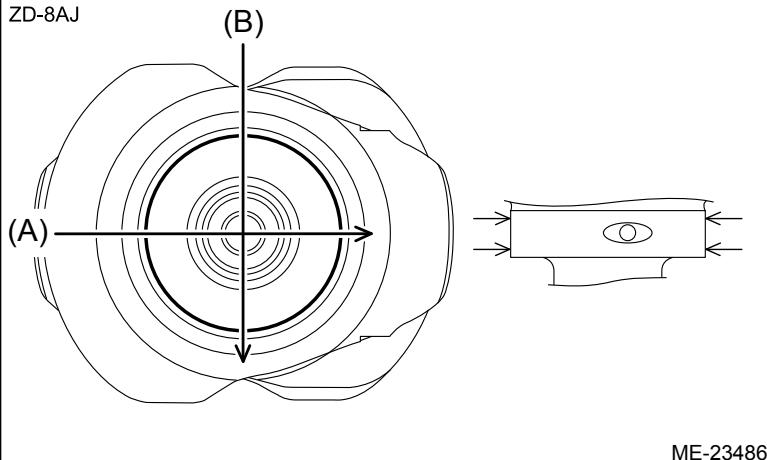
Caution:

During the check, be careful not to damage the cylinder block by the connecting rod.

Note:

- Measurement should be performed at a temperature of 20°C (68°F).
- For the outer diameter of crankshaft journal, read the value of most worn location of all the measurement values.
- Measure the crankshaft journal outer diameter in the lateral and longitudinal directions at the locations shown in the figure.

ZD-8AJ



ME-23486

(A) Lateral direction

(B) Longitudinal direction

- Calculate the cylindricality of crankshaft journal by using the following formula.

Calculation formula

C = The larger value between the calculation values C' and C''

C' = $(D(a) - D(b))/2$

C'' = $(D(c) - D(d))/2$

C: Cylindricality of crankshaft journal

D (a): The larger value between the measurement values in the lateral direction

D (b): The smaller value between the measurement values in the lateral direction

- D (c): The larger value between the measurement values in the longitudinal direction
- D (d): The smaller value between the measurement values in the longitudinal direction

- **Calculate the out-of-roundness of crankshaft journal at each measurement locations (2 locations) by using the following formula.**

Calculation formula

$$R = (D(e) - D(f))/2$$

R: Out-of-roundness of crankshaft journal

D (e): The larger value between the measurement values in the lateral and longitudinal directions

D (f): The smaller value between the measurement values in the lateral and longitudinal directions

- **When replacing the crankshaft, check the following items.**

- **When replacing the crankshaft, it is also necessary to replace all the connecting rod & connecting rod bearing set and crankshaft bearing that are used after engine is started with new parts.**
- **For replacement of the connecting rod & connecting rod bearing set, refer to step 3. - (4) in "Connecting rod & crankshaft".  Ref. to MECHANICAL(H4DO)>Cylinder Block>INSPECTION > CONNECTING ROD & CRANKSHAFT.**
- **For replacement of the crankshaft bearing, refer to step 5.**

Crankshaft journal:

Cylindricality

Limit

0.006 mm (0.0002 in)

Out-of-roundness

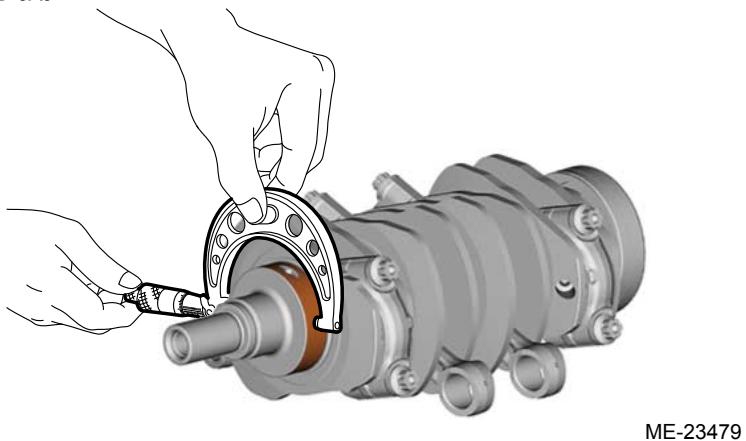
Limit

0.005 mm (0.0002 in)

Service limit (dia.)

67.985 mm (2.6766 in) or less

ZD-8AJ



4. Inspect the crankshaft bearing for scar, peeling, seizure, melting or wear, etc.
5. Use a thickness gauge to check the thrust clearance of crankshaft at thrust of #5 crankshaft bearing. If it is not within the standard, replace the #5 crankshaft bearing, and replace the crankshaft as required.

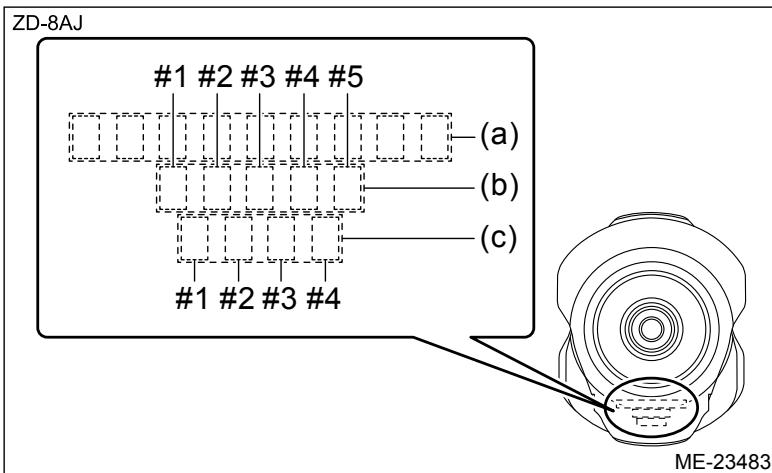
Caution:

During the check, be careful not to damage the cylinder block by the connecting rod.

Note:

- Measurement should be performed at a temperature of 20°C (68°F).
- Set all the crankshaft bearings onto the cylinder block, then mount the crankshaft together with the connecting rod on the cylinder block, and use a thickness gauge to measure the thrust clearance of crankshaft.
- When replacing the crankshaft bearing, select the crankshaft bearing of suitable size from the table below using the diameter range of the crankshaft journal stamped on the crankshaft and the main journal size mark stamped on the upper face of the cylinder block. After selecting, check the oil clearance on the crankshaft bearing in step 6. using a new crankshaft bearing.

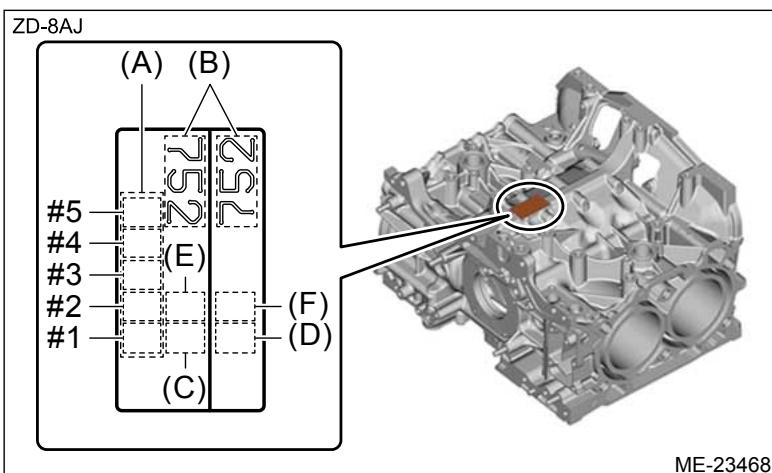
Example) When replacing the #5 crankshaft bearing, the diameter range of crankshaft journal is "C" and the main journal size mark is "2", select "STD2" from the table for #5 crankshaft bearing.

Crankshaft

(a) Control No.

(b) Diameter range of crankshaft journal

(c) Diameter range of crankshaft pin

Cylinder block

(A) Main journal size mark

(C) RH front cylinder bore size mark

(E) RH rear cylinder bore size mark

(B) Cylinder block (RH) – (LH)

(D) LH front cylinder bore size

(F) LH rear cylinder bore size

combination mark

mark

mark

#1, #3 Crankshaft bearing

		Main journal size mark {Main journal inner diameter}		
		1 {73.012 — 73.018 mm (2.8745 — 2.8747 in)}}	2 {73.006 — 73.012 mm (2.8742 — 2.8745 in)}}	3 {73.000 — 73.006 mm (2.8740 — 2.8742 in)}}
Diameter range of crankshaft journal {Crankshaft journal outer diameter}	B {67.997 — 68.003 mm (2.6770 — 2.6773 in)}}	STD3 (Identification stamp 3)	STD4 (Identification stamp 4)	STD5 (Identification stamp 5)
	C {67.991 — 67.997 mm (2.6768 — 2.6770 in)}}	STD2 (Identification stamp 2)	STD3 (Identification stamp 3)	STD4 (Identification stamp 4)
	D {67.985 — 67.991 mm (2.6766 — 2.6768 in)}}	STD1 (Identification stamp 1)	STD2 (Identification stamp 2)	STD3 (Identification stamp 3)

#2, #4 Crankshaft bearing

		Main journal size mark {Main journal inner diameter}		
		1 {73.012 — 73.018 mm (2.8745 — 2.8747 in)}}	2 {73.006 — 73.012 mm (2.8742 — 2.8745 in)}}	3 {73.000 — 73.006 mm (2.8740 — 2.8742 in)}}
Diameter range of crankshaft journal {Crankshaft journal outer diameter}	B {67.997 — 68.003 mm (2.6770 — 2.6773 in)}}	STD2 (Identification stamp 2)	STD3 (Identification stamp 3)	STD4 (Identification stamp 4)
	C {67.991 — 67.997 mm (2.6768 — 2.6770 in)}}	STD1 (Identification stamp 1)	STD2 (Identification stamp 2)	STD3 (Identification stamp 3)

	D {67.985 — 67.991 mm (2.6766 — 2.6768 in)}	STD0 (Identification stamp 0)	STD1 (Identification stamp 1)	STD2 (Identification stamp 2)
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#5 Crankshaft bearing

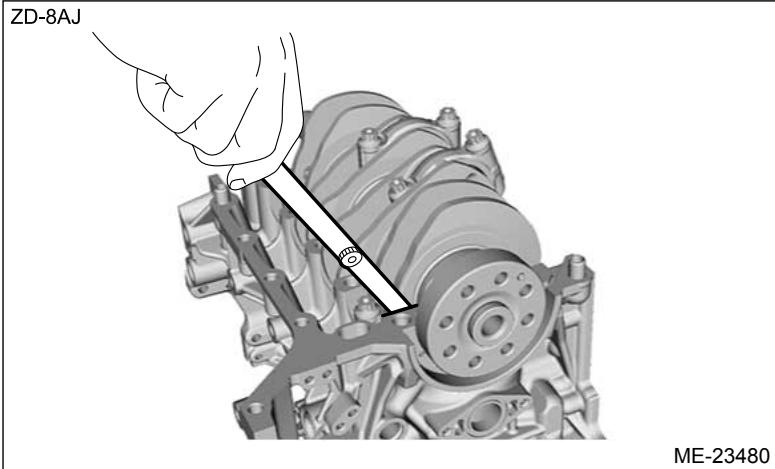
		Main journal size mark {Main journal inner diameter}		
		1 {73.012 — 73.018 mm (2.8745 — 2.8747 in)}	2 {73.006 — 73.012 mm (2.8742 — 2.8745 in)}	3 {73.000 — 73.006 mm (2.8740 — 2.8742 in)}
Diameter range of crankshaft journal {Crankshaft journal outer diameter}	B {67.997 — 68.003 mm (2.6770 — 2.6773 in)}	STD2 (Identification stamp 2)	STD3 (Identification stamp 3)	STD4 (Identification stamp 4)
	C {67.991 — 67.997 mm (2.6768 — 2.6770 in)}	STD1 (Identification stamp 1)	STD2 (Identification stamp 2)	STD3 (Identification stamp 3)
	D {67.985 — 67.991 mm (2.6766 — 2.6768 in)}	STD0 (Identification stamp 0)	STD1 (Identification stamp 1)	STD2 (Identification stamp 2)

- When replacing the crankshaft, check the following items.
 - When replacing the crankshaft, it is also necessary to replace all the connecting rod & connecting rod bearing set and crankshaft bearing that are used after engine is started with new parts.
 - For replacement of the connecting rod & connecting rod bearing set, refer to step 3. - (4) in “Connecting rod & crankshaft”.  [Ref. to MECHANICAL\(H4DO\)>Cylinder Block>INSPECTION > CONNECTING ROD & CRANKSHAFT.](#)
 - When replacing the crankshaft bearing, select the crankshaft bearing of suitable size by referring to the instructions above. After selecting, check the oil clearance on the crankshaft bearing in step 6. using a new crankshaft bearing. When replacing also the cylinder block with a new part, refer to the assembly in “Crankshaft” after selecting, as no oil clearance check is required for the crankshaft bearing.  [Ref. to MECHANICAL\(H4DO\)>Cylinder Block>INSTALLATION.](#)

Crankshaft thrust clearance:

Standard

0.130 — 0.308 mm (0.0051 — 0.0121 in)



ME-23480

6. Check the oil clearance on each crankshaft bearing using plastigauge. If it is not within the standard, replace the crankshaft bearing, and replace the crankshaft as required. When replacing the crankshaft bearing, refer to step 5.

Note:

- Measurement should be performed at a temperature of 20°C (68°F).
- When replacing the crankshaft, check the following items.
 - When replacing the crankshaft, it is also necessary to replace all the connecting rod & connecting rod bearing set and crankshaft bearing that are used after engine is started with new parts.
 - For replacement of the connecting rod & connecting rod bearing set, refer to step 3. - (4) in "Connecting rod & crankshaft". [Ref. to MECHANICAL\(H4DO\)>Cylinder Block>INSPECTION > CONNECTING ROD & CRANKSHAFT.](#)
 - For replacement of the crankshaft bearing, refer to step 5.

(1) Clean each crankshaft bearing and crankshaft journal.

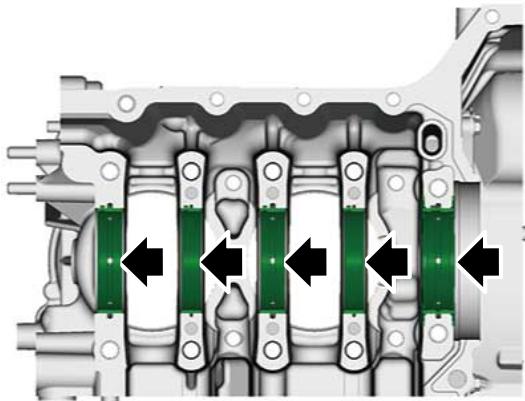
(2) Set the crankshaft bearing to the cylinder block.

Caution:

- Place a wood board wrapped with a waste cloth to prevent the knock pin damage and to stabilize the cylinder block before work.
- Be careful not to scratch the mating surface with the cylinder head during work.

- RH side

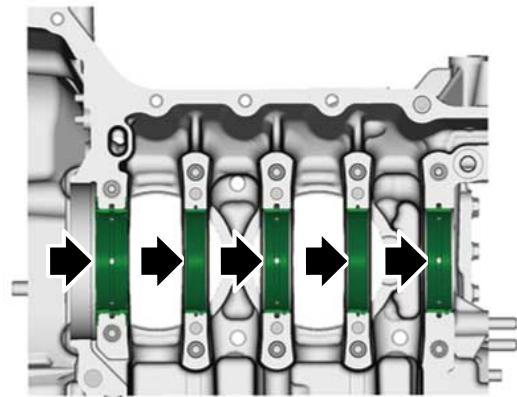
ZD-8AJ



ME-23428

- LH side

ZD-8AJ



ME-23429

(3) Set the crankshaft together with the connecting rod to the cylinder block LH.

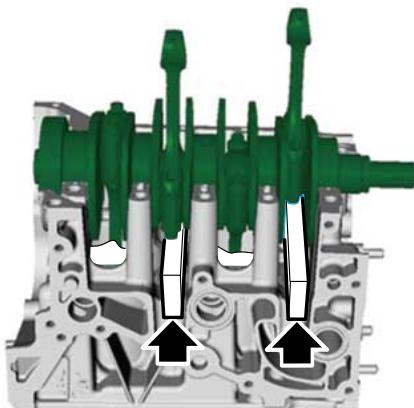
Caution:

Before setting the crankshaft together with the connecting rod, wrap the connecting rod small end on the cylinder block LH side with cloth, etc. to protect the cylinder.

Note:

Using a wood board, etc., adjust the connecting rod on the cylinder block RH side to a position where it can be inserted into the cylinder block RH, and hold it.

ZD-8AJ



ME-23431

(4) Place a plastigauge across the crankshaft journals and set the cylinder block RH to the cylinder block

LH.

- (5) Join the cylinder blocks.

Caution:

When tightening the mounting bolts, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.

- 1) Apply a coat of engine oil to the washers and cylinder block mounting bolt threads.

Note:

To prevent mixture of engine oil into the water jacket, do not apply a large amount.

- 2) Tighten all mounting bolts with a torque of 35 N·m (3.6 kgf-m, 25.8 ft-lb) in numerical order as shown in the figure.

- 3) Loosen all mounting bolts by 180° in the reverse order of tightening in step 2).

- 4) Tighten all mounting bolts with a torque of 35 N·m (3.6 kgf-m, 25.8 ft-lb) in numerical order as shown in the figure.

- 5) Loosen the mounting bolts (4 places) by 180° in the order of 6 → 5 → 4 → 3 as shown in the figure.

- 6) Tighten the mounting bolts (4 places) with a torque of 17 N·m (1.7 kgf-m, 12.5 ft-lb) in the order of 3 → 4 → 5 → 6 as shown in the figure.

- 7) Using an angle gauge, tighten the mounting bolts (4 places) by 58 – 62 ° in the order of 3 → 4 → 5 → 6 as shown in the figure.

- 8) Loosen the mounting bolts (6 places) by 180° in the order of 8 → 7 → 10 → 9 → 2 → 1 as shown in the figure.

- 9) Tighten the mounting bolts (6 places) with a torque of 17 N·m (1.7 kgf-m, 12.5 ft-lb) in the order of 1 → 2 → 9 → 10 → 7 → 8 as shown in the figure.

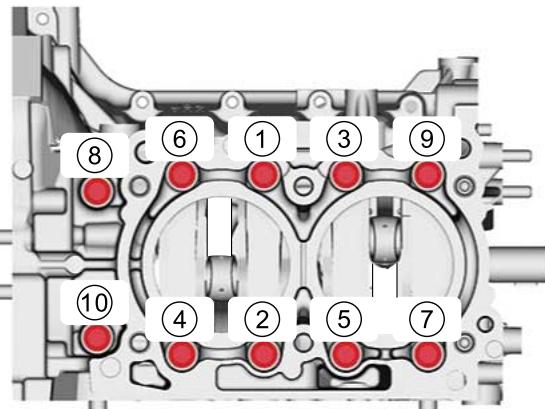
- 10) Using an angle gauge, tighten the mounting bolts (3 places) by 58 – 62 ° in the order of 1 → 2 → 9 as shown in the figure.

- 11) Using an angle gauge, tighten the mounting bolt 10 (1 place) shown in the figure by 78 – 82 °.

- 12) Using an angle gauge, tighten the mounting bolt 7 (1 place) shown in the figure by 58 – 62 °.

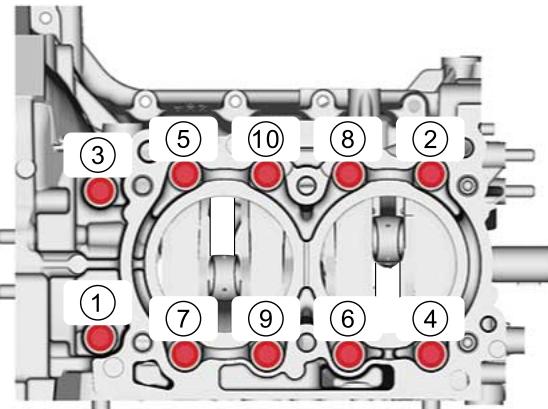
- 13) Using an angle gauge, tighten the mounting bolt 8 (1 place) shown in the figure by 78 – 82 °.

ZD-8AJ



ME-23433

- (6) Loosen the cylinder block mounting bolts in numerical order as shown in the figure, and then remove the bolts.



ME-23481

- (7) While tapping the cylinder block RH with a plastic hammer, separate the cylinder block RH from the cylinder block LH.

Caution:

When separating the cylinder block, be careful not to damage the cylinder block by the connecting rod.

Note:

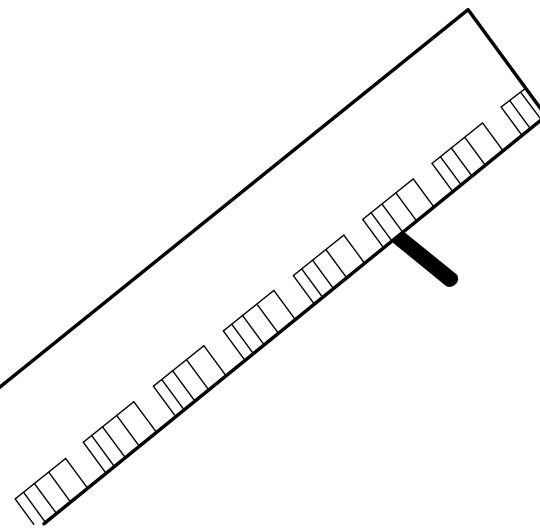
Lift the cylinder block RH gradually, and confirm that the crankshaft is remaining in the cylinder block LH. Lifting the cylinder block RH carelessly may cause the crankshaft to fall off.

- (8) Determine the crankshaft oil clearance by matching the widest point of the plastigauge on each journal against scale printed on a package of the plastigauge.

Crankshaft oil clearance:

Standard

0.013 – 0.031 mm (0.0005 – 0.0012 in)



ME-06108

7. REAR OIL SEAL

- 1.** Check that there is no oil leaking from rear oil seal. If there is any oil leak, replace the rear oil seal with a new part according to the following procedures described below.

(1) When working on the vehicle

Note:

When working on the vehicle, perform the following steps also.

- 1) Remove the transmission main body from the vehicle.

AT model:

[Ref. to AUTOMATIC TRANSMISSION>Transmission Assembly>REMOVAL.](#)

MT model:

[Ref. to MANUAL TRANSMISSION>Transmission Assembly>REMOVAL.](#)

- (2) Remove the crankshaft position sensor plate with drive plate. (AT model) [Ref. to AUTOMATIC TRANSMISSION>Drive Plate>REMOVAL.](#)

- (3) Remove the crankshaft position sensor plate with flywheel. (MT model) [Ref. to CLUTCH SYSTEM>Flywheel>REMOVAL](#)

- (4) Remove the rear oil seal from cylinder block using the oil seal puller, etc.

Caution:

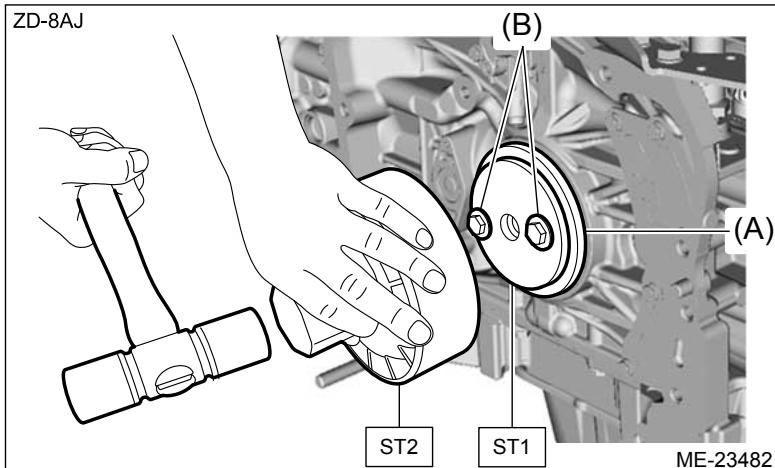
Be careful not to damage the crankshaft during work.

- (5) Apply a thin coat of engine oil to the oil seal inner periphery and outer periphery, and install new rear oil seal using ST1 and ST2.

Preparation tool:

ST1: OIL SEAL GUIDE (18671AA020)

ST2: OIL SEAL INSTALLER (18657AA030)



(A) Rear oil seal

(B) Drive plate or flywheel
mounting bolt

- (6) Install in the reverse order of removal after replacement.

MECHANICAL(H4DO) > Intake and Exhaust Valve

REMOVAL

Refer to "Cylinder Head" for removal procedures of the intake and exhaust valves.

-  [Ref. to MECHANICAL\(H4DO\)>Cylinder Head>REMOVAL.](#)
-  [Ref. to MECHANICAL\(H4DO\)>Cylinder Head>DISASSEMBLY.](#)

MECHANICAL(H4DO) > Intake and Exhaust Valve

INSTALLATION

Refer to "Cylinder Head" for installation procedures of the intake and exhaust valves.

-  [Ref. to MECHANICAL\(H4DO\)>Cylinder Head>ASSEMBLY.](#)
-  [Ref. to MECHANICAL\(H4DO\)>Cylinder Head>INSTALLATION.](#)

MECHANICAL(H4DO) > Intake and Exhaust Valve

INSPECTION

Refer to "Cylinder Head" for inspection procedures of the intake and exhaust valves.

-  [Ref. to MECHANICAL\(H4DO\)>Cylinder Head>INSPECTION.](#)

MECHANICAL(H4DO) > Piston

REMOVAL

Refer to "Cylinder Block" for removal procedures of pistons.

-  [Ref. to MECHANICAL\(H4DO\)>Cylinder Block>REMOVAL.](#)
-  [Ref. to MECHANICAL\(H4DO\)>Cylinder Block>DISASSEMBLY > CONNECTING ROD & CRANKSHAFT.](#)

MECHANICAL(H4DO) > Piston

INSTALLATION

Refer to "Cylinder Block" for installation procedures of pistons.

-  [Ref. to MECHANICAL\(H4DO\)>Cylinder Block>ASSEMBLY > CONNECTING ROD & CRANKSHAFT.](#)
-  [Ref. to MECHANICAL\(H4DO\)>Cylinder Block>INSTALLATION.](#)

MECHANICAL(H4DO) > Piston

INSPECTION

Refer to "Cylinder Block" for inspection procedures of pistons.

-  [Ref. to MECHANICAL\(H4DO\)>Cylinder Block>INSPECTION.](#)

MECHANICAL(H4DO) > Connecting Rod

REMOVAL

Refer to "Cylinder Block" for removal procedures of connecting rod.

-  [Ref. to MECHANICAL\(H4DO\)>Cylinder Block>REMOVAL.](#)
-  [Ref. to MECHANICAL\(H4DO\)>Cylinder Block>DISASSEMBLY > CONNECTING ROD & CRANKSHAFT.](#)

MECHANICAL(H4DO) > Connecting Rod

INSTALLATION

Refer to "Cylinder Block" for installation procedures of connecting rod.

-  [Ref. to MECHANICAL\(H4DO\)>Cylinder Block>ASSEMBLY > CONNECTING ROD & CRANKSHAFT.](#)
-  [Ref. to MECHANICAL\(H4DO\)>Cylinder Block>INSTALLATION.](#)

MECHANICAL(H4DO) > Connecting Rod

INSPECTION

Refer to "Cylinder Block" for inspection procedures of connecting rod.

-  [Ref. to MECHANICAL\(H4DO\)>Cylinder Block>INSPECTION.](#)

MECHANICAL(H4DO) > Crankshaft

REMOVAL

Refer to "Cylinder Block" for removal procedures of the crankshaft.

-  [Ref. to MECHANICAL\(H4DO\)>Cylinder Block>REMOVAL.](#)
-  [Ref. to MECHANICAL\(H4DO\)>Cylinder Block>DISASSEMBLY > CONNECTING ROD & CRANKSHAFT.](#)

MECHANICAL(H4DO) > Crankshaft

INSTALLATION

Refer to "Cylinder Block" for inspection procedures of the crankshaft.

-  [Ref. to MECHANICAL\(H4DO\)>Cylinder Block>ASSEMBLY > CONNECTING ROD & CRANKSHAFT.](#)
-  [Ref. to MECHANICAL\(H4DO\)>Cylinder Block>INSTALLATION.](#)

MECHANICAL(H4DO) > Crankshaft

INSPECTION

Refer to "Cylinder Block" for inspection procedures of the crankshaft.

-  [Ref. to MECHANICAL\(H4DO\)>Cylinder Block>INSPECTION.](#)

MECHANICAL(H4DO) > Symptoms and causes

INSPECTION

Note:

The "RANK" shown in the chart shows the possibilities of the cause of trouble in order from "Very often" to "Rarely".

A — Very often

B — Sometimes

C — Rarely

Symptoms	Problem parts etc.	Possible cause	RANK
1. Engine does not start.			
1) Starter does not turn.	Starter	Defective battery-to-starter harness	B
		Defective starter switch	C
		Defective relay	C
		Defective inhibitor switch	C
		Defective clutch start switch or clutch switch	C
		Defective starter	B
	Battery	Improper connection of terminal	A
		Run-down battery	A
		Defective charging system	B
	Friction	Seizure of crankshaft and connecting rod bearing	C
		Seized camshaft	C
		Seized or stuck piston and cylinder	C
	Keyless access system  Ref. to KEYLESS ACCESS WITH PUSH BUTTON START(DIAGNOSTICS)>Basic Diagnostic Procedure.		A
2) Initial combustion does not occur.	Starter	Defective starter	C
	Engine control system  Ref. to ENGINE (DIAGNOSTICS). (H4DO)>Basic Diagnostic Procedure.		A
	Fuel line	Defective fuel pump and relay	A
		Clogged fuel line	C
		Lack of fuel or insufficient fuel	B
	Timing chain	Trouble	B
		Defective timing	B
	Compression	Incorrect cam clearance	C
		Loosened spark plug or defective gasket	C
		Loosened cylinder head bolt or defective cylinder head gasket	C
		Improper valve sealing	C

	Defective valve stem	C	
	Worn or broken valve spring	B	
	Worn or stuck piston rings, cylinder liner and piston	C	
	Incorrect valve timing	B	
	Improper engine oil (low viscosity)	B	
3) Initial combustion occurs.	Engine control system  Ref. to ENGINE (DIAGNOSTICS) (H4DO)>Basic Diagnostic Procedure.	A	
	Intake system	Defective intake manifold gasket Defective throttle body gasket	B B
	Fuel line	Defective fuel pump and relay Clogged fuel line Lack of fuel or insufficient fuel	C C B
	Timing chain	Trouble Defective timing	B B
	Compression	Incorrect cam clearance Loosened spark plug or defective gasket Loosened cylinder head bolt or defective cylinder head gasket Improper valve sealing Defective valve stem Worn or broken valve spring Worn or stuck piston rings, cylinder liner and piston Incorrect valve timing Improper engine oil (low viscosity)	C C C C C B C B B
4) Engine stalls after initial combustion.	Engine control system  Ref. to ENGINE (DIAGNOSTICS) (H4DO)>Basic Diagnostic Procedure.	A	
	Intake system	Loosened or cracked intake duct Loosened or cracked PCV hose Loosened or cracked vacuum hose Defective intake manifold gasket Defective throttle body gasket Dirty air cleaner element	B C C B B C
	Fuel line	Clogged fuel line Lack of fuel or insufficient fuel	C B
	Timing chain	Trouble Defective timing	B B
	Compression	Incorrect cam clearance Loosened spark plug or defective gasket	C C

	Loosened cylinder head bolt or defective cylinder head gasket	C
	Improper valve sealing	C
	Defective valve stem	C
	Worn or broken valve spring	B
	Worn or stuck piston rings, cylinder and piston	C
	Incorrect valve timing	B
	Improper engine oil (low viscosity)	B
2. Rough idle and engine stall	Engine control system  Ref. to ENGINE (DIAGNOSTICS) (H4DO)>Basic Diagnostic Procedure.	A
Intake system	Loosened or cracked intake duct	A
	Loosened or cracked PCV hose	A
	Loosened or cracked vacuum hose	A
	Defective intake manifold gasket	B
	Defective throttle body gasket	B
	Defective PCV valve	C
	Loosened oil filler cap	B
	Dirty air cleaner element	C
Fuel line	Defective fuel pump and relay	C
	Clogged fuel line	C
	Lack of fuel or insufficient fuel	B
Timing chain	Defective timing	C
Compression	Incorrect cam clearance	B
	Loosened spark plug or defective gasket	B
	Loosened cylinder head bolt or defective cylinder head gasket	B
	Improper valve sealing	B
	Defective valve stem	C
	Worn or broken valve spring	B
	Worn or stuck piston rings, cylinder and piston	B
	Incorrect valve timing	A
	Improper engine oil (low viscosity)	B
Lubrication system	Incorrect oil pressure	B
	Defective rocker cover gasket	C
Cooling system	Over-heating	C
Other	Evaporative emission control system malfunction	A
	Stuck or damaged throttle valve	B

	Crankshaft bearing damaged due to engine overspeed (seizure, etc.)	C																		
	<p>Note:</p> <p>Check the control operation history (maximum engine speed). If the control operation history is recorded, abnormal high rotation of engine due to improper gear operation, etc. may be the cause. After repairing the faulty parts, advise the user.  Ref. to ENGINE (DIAGNOSTICS) (H4DO)>Diagnostics with Phenomenon>LIST.</p>																			
3. Low output, hesitation and poor acceleration	Engine control system  Ref. to ENGINE (DIAGNOSTICS) (H4DO)>Basic Diagnostic Procedure.	A																		
	Intake system	<table border="1"> <tr><td>Loosened or cracked intake duct</td><td>A</td></tr> <tr><td>Loosened or cracked PCV hose</td><td>A</td></tr> <tr><td>Loosened or cracked vacuum hose</td><td>B</td></tr> <tr><td>Defective intake manifold gasket</td><td>B</td></tr> <tr><td>Defective throttle body gasket</td><td>B</td></tr> <tr><td>Defective PCV valve</td><td>B</td></tr> <tr><td>Loosened oil filler cap</td><td>B</td></tr> <tr><td>Dirty air cleaner element</td><td>A</td></tr> </table>	Loosened or cracked intake duct	A	Loosened or cracked PCV hose	A	Loosened or cracked vacuum hose	B	Defective intake manifold gasket	B	Defective throttle body gasket	B	Defective PCV valve	B	Loosened oil filler cap	B	Dirty air cleaner element	A		
Loosened or cracked intake duct	A																			
Loosened or cracked PCV hose	A																			
Loosened or cracked vacuum hose	B																			
Defective intake manifold gasket	B																			
Defective throttle body gasket	B																			
Defective PCV valve	B																			
Loosened oil filler cap	B																			
Dirty air cleaner element	A																			
	Fuel line	<table border="1"> <tr><td>Defective fuel pump and relay</td><td>B</td></tr> <tr><td>Clogged fuel line</td><td>B</td></tr> <tr><td>Lack of fuel or insufficient fuel</td><td>C</td></tr> </table>	Defective fuel pump and relay	B	Clogged fuel line	B	Lack of fuel or insufficient fuel	C												
Defective fuel pump and relay	B																			
Clogged fuel line	B																			
Lack of fuel or insufficient fuel	C																			
	Timing chain	Defective timing																		
	Compression	<table border="1"> <tr><td>Incorrect cam clearance</td><td>B</td></tr> <tr><td>Loosened spark plug or defective gasket</td><td>B</td></tr> <tr><td>Loosened cylinder head bolt or defective cylinder head gasket</td><td>B</td></tr> <tr><td>Improper valve sealing</td><td>B</td></tr> <tr><td>Defective valve stem</td><td>C</td></tr> <tr><td>Worn or broken valve spring</td><td>B</td></tr> <tr><td>Worn or stuck piston rings, cylinder and piston</td><td>C</td></tr> <tr><td>Incorrect valve timing</td><td>A</td></tr> <tr><td>Improper engine oil (low viscosity)</td><td>B</td></tr> </table>	Incorrect cam clearance	B	Loosened spark plug or defective gasket	B	Loosened cylinder head bolt or defective cylinder head gasket	B	Improper valve sealing	B	Defective valve stem	C	Worn or broken valve spring	B	Worn or stuck piston rings, cylinder and piston	C	Incorrect valve timing	A	Improper engine oil (low viscosity)	B
Incorrect cam clearance	B																			
Loosened spark plug or defective gasket	B																			
Loosened cylinder head bolt or defective cylinder head gasket	B																			
Improper valve sealing	B																			
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Worn or stuck piston rings, cylinder and piston	C																			
Incorrect valve timing	A																			
Improper engine oil (low viscosity)	B																			
	Lubrication system	Incorrect oil pressure																		
	Cooling system	<table border="1"> <tr><td>Over-heating</td><td>C</td></tr> <tr><td>Over-cooling</td><td>C</td></tr> </table>	Over-heating	C	Over-cooling	C														
Over-heating	C																			
Over-cooling	C																			

Other	Evaporative emission control system malfunction	A
	Crankshaft bearing damaged due to engine overspeed (seizure, etc.)	C
<p>Note:</p> <p>Check the control operation history (maximum engine speed). If the control operation history is recorded, abnormal high rotation of engine due to improper gear operation, etc. may be the cause. After repairing the faulty parts, advise the user.  Ref. to ENGINE (DIAGNOSTICS)</p> <p>(H4DO)>Diagnostics with Phenomenon>LIST.</p>		
4. Surging	Engine control system  Ref. to ENGINE (DIAGNOSTICS)	A
	(H4DO)>Basic Diagnostic Procedure.	
Intake system	Loosened or cracked intake duct	A
	Loosened or cracked PCV hose	A
	Loosened or cracked vacuum hose	A
	Defective intake manifold gasket	B
	Defective throttle body gasket	B
	Defective PCV valve	B
	Loosened oil filler cap	B
	Dirty air cleaner element	B
Fuel line	Defective fuel pump and relay	B
	Clogged fuel line	B
	Lack of fuel or insufficient fuel	C
Timing chain	Defective timing	B
Compression	Incorrect cam clearance	B
	Loosened spark plug or defective gasket	C
	Loosened cylinder head bolt or defective cylinder head gasket	C
	Improper valve sealing	C
	Defective valve stem	C
	Worn or broken valve spring	C
	Worn or stuck piston rings, cylinder and piston	C
	Incorrect valve timing	A
	Improper engine oil (low viscosity)	B
Cooling system	Over-heating	B

	Other	Evaporative emission control system malfunction	C
5. Engine does not return to idle.	Engine control system  Ref. to ENGINE (DIAGNOSTICS) . (H4DO)>Basic Diagnostic Procedure.		A
	Intake system	Loosened or cracked vacuum hose	A
	Other	Stuck or damaged throttle valve	A
6. Dieseling (run-on)	Engine control system  Ref. to ENGINE (DIAGNOSTICS) . (H4DO)>Basic Diagnostic Procedure.		A
	Cooling system	Over-heating	B
	Other	Evaporative emission control system malfunction	B
7. After burning in exhaust system	Engine control system  Ref. to ENGINE (DIAGNOSTICS) . (H4DO)>Basic Diagnostic Procedure.		A
	Intake system	Loosened or cracked intake duct	C
		Loosened or cracked PCV hose	C
		Loosened or cracked vacuum hose	B
		Defective PCV valve	B
		Loosened oil filler cap	C
	Timing chain	Defective timing	B
	Compression	Incorrect cam clearance	B
		Loosened spark plug or defective gasket	C
		Loosened cylinder head bolt or defective cylinder head gasket	C
		Improper valve sealing	B
		Defective valve stem	C
		Worn or broken valve spring	C
		Worn or stuck piston rings, cylinder and piston	C
		Incorrect valve timing	A
	Lubrication system	Incorrect oil pressure	C
	Cooling system	Over-cooling	C
	Other	Evaporative emission control system malfunction	C
8. Knocking	Engine control system  Ref. to ENGINE (DIAGNOSTICS) . (H4DO)>Basic Diagnostic Procedure.		A
	Intake system	Loosened oil filler cap	B
	Timing chain	Defective timing	B
	Compression	Incorrect cam clearance	C
		Incorrect valve timing	B
	Cooling system	Over-heating	A

9. Excessive engine oil consumption	Intake system	Loosened or cracked PCV hose	A
		Defective PCV valve	B
		Loosened oil filler cap	C
	Compression	Defective valve stem	A
		Worn or stuck piston rings, cylinder and piston	A
	Lubrication system	Loosened chain cover attaching bolts and defective gasket	B
		Defective oil filter gasket	B
		Defective crankshaft oil seal	B
		Defective rocker cover gasket	B
		Loosened oil drain plug or defective gasket	B
		Loosened oil pan mounting bolt or defective oil pan	B
10. Excessive fuel consumption	Engine control system  Ref. to ENGINE (DIAGNOSTICS) . (H4DO)>Basic Diagnostic Procedure.		A
	Intake system	Dirty air cleaner element	A
	Timing chain	Defective timing	B
	Compression	Incorrect cam clearance	B
		Loosened spark plug or defective gasket	C
		Loosened cylinder head bolt or defective cylinder gasket	C
		Improper valve sealing	B
		Defective valve stem	C
		Worn or broken valve spring	C
		Worn or stuck piston rings, cylinder and piston	B
	Incorrect valve timing		B
	Lubrication system	Incorrect oil pressure	C
	Cooling system	Over-cooling	C
11. Engine output decrease, abnormal noise, vibration due to idling trouble	Engine control system  Ref. to ENGINE (DIAGNOSTICS) . (H4DO)>Basic Diagnostic Procedure.		C

MECHANICAL(H4DO) > Engine Noise

INSPECTION

Type of sound	Condition	Possible cause
Regular clicking sound	Sound increases as engine speed increases.	<ul style="list-style-type: none"> Valve mechanism is defective Incorrect cam clearance Worn camshaft Broken valve spring Defective valve shim
Heavy and dull clank	Oil pressure is low.	<ul style="list-style-type: none"> Worn crankshaft bearing Worn connecting rod bearing
	Oil pressure is normal.	<ul style="list-style-type: none"> Loosened flywheel mounting bolt Damaged engine mounting
High-pitched clank	Sound is noticeable when accelerating with an overload condition.	<ul style="list-style-type: none"> Ignition timing advanced Accumulation of carbon inside combustion chamber Wrong heat range of spark plug Improper octane value gasoline
Clank noise when engine speed is (1,000 – 2,000 r/min)	Sound is reduced when the fuel injector of the noisy cylinder is stopped. *	<ul style="list-style-type: none"> Worn crankshaft bearing Worn connecting rod bearing
Knocking sound when engine is operating under idling speed and engine is warm	Sound is reduced when the fuel injector of the noisy cylinder is stopped. *	<ul style="list-style-type: none"> Worn cylinder liner and piston ring Broken or stuck piston ring Worn piston pin and piton pin hole of piston
	Sound is not reduced if each fuel injector is stopped in turn. *	<ul style="list-style-type: none"> Unusually worn valve rocker Unusually worn valve shim Worn cam sprocket Worn journal of cam carrier and camshaft cap
Squeaky sound	—	<ul style="list-style-type: none"> Insufficient generator lubrication
Rubbing sound	—	<ul style="list-style-type: none"> Poor contact of generator brush and rotor
Gear scream when starting engine	—	<ul style="list-style-type: none"> Defective ignition starter switch Worn gear and starter pinion
Sound like polishing glass with a dry cloth	—	<ul style="list-style-type: none"> Defective V-belt tensioner assembly (loose V-belt) Defective water pump shaft
Hissing sound	—	<ul style="list-style-type: none"> Insufficient compression Air leakage in air intake system, hose, connection or manifold
Timing chain noise	—	<ul style="list-style-type: none"> Loose timing chain Timing chain contacting with adjacent part

Valve noise

—

• Incorrect cam clearance

*: Fuel injector can be stopped using the Subaru Select Monitor.  [Ref. to ENGINE \(DIAGNOSTICS\) \(H4DO\)>Active Test>OPERATION.](#)